PROJECT MANUAL

Wastewater Treatment Facility Improvements

0M2.131536

City of Spring Valley, MN

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CERTIFICATIONS PAGE

PROJECT MANUAL

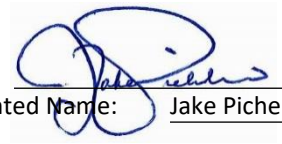
FOR

WASTEWATER TREATMENT FACILITY IMPROVEMENTS

0M2.131536

CITY OF SPRING VALLEY, MN

I hereby certify that this plan, specification, or report 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.

Signature: 

Typed or Printed Name: Jake Pichelmann, P.E.

Date: 09/29/2026 License Number: 54296

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City of Spring Valley, Minnesota

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DRAWINGS (UNDER SEPARATE COVER):

209 sheets numbered 1.01 through 7.37, inclusive, dated 09/29/2026, and with each sheet bearing the following general title:

Wastewater Treatment Facility Improvements
City of Spring Valley, Minnesota

******END OF SECTION******

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ADVERTISEMENT FOR BIDS
WASTEWATER TREATMENT FACILITY IMPROVEMENTS
CITY OF SPRING VALLEY, MN

RECEIPT AND OPENING OF PROPOSALS: Proposals for the work described below will be received online through QuestCDN.com until 2:00 p.m. on October 27, 2026, at which time the bids will be opened and publicly read at the office of the City Administrator, City of Spring Valley, 201 South Broadway, Spring Valley, MN 55975, through Microsoft Teams. Please use the below link or call-in number/Conference ID to see and/or hear the bid opening results:

1. Microsoft Teams Link: https://bit.ly/SpringValleyWWTF
2. Call: 1-612-428-8778 / Conference ID: 809 579 669#

DESCRIPTION OF WORK: The work includes the construction of approximately:

1. Main lift station and forcemain improvements.
2. Renovation of the existing pretreatment building and replacement of mechanical fine screen equipment.
3. Biological treatment renovations, including concrete basin modifications, new aeration and mixing equipment, new clarifiers and control structures, and submersible pumping.
4. Chemical feed improvements, including replacement of gaseous chlorine and sulfur dioxide equipment and installation of new carbon feed.
5. Construction of a new effluent re-aeration system, including precast structure, positive displacement blower, and aeration equipment.
6. Renovations of the existing aerated solids storage facilities, including new coarse bubble mixing improvements, sludge pumping, and sludge loadout.
7. Renovation to other existing buildings, including the disinfection, digestion, and administration buildings. Construction of a new masonry building for electrical equipment.
8. Decommissioning and demolition of existing processes as required.
9. Site work, utility, and pavement improvements.
10. Electrical, instrumentation, control, and SCADA system improvements.

Together with numerous related items of work, all in accordance with Plans and Specifications. This project is subject to Prevailing Wage Rates, Disadvantaged Business Enterprise Goals, Responsible Contractor Certification, Build America Buy America (BABA), and other applicable state and federal requirements, as required by the Minnesota Public Facilities Authority (PFA) State Revolving Fund program for funding.

COMPLETION OF WORK: The work must be substantially complete within seven hundred thirty (730) calendar days, and all work completed and ready for final payment within eight hundred twenty (820) calendar days after receipt of Notice to Proceed.

PLAN HOLDERS LIST, ADDENDUMS, AND BID TABULATION: The plan holders list, addendums, and bid tabulations will be available for download online at www.questcdn.com or www.bolton-menk.com.

TO OBTAIN BID DOCUMENTS: Complete digital project bidding documents are available at www.questcdn.com or www.bolton-menk.com. You may view the digital plan documents for free by entering Quest project #10378032 on the website's Project Search page. Documents may be downloaded for $50.00. Please contact QuestCDN.com at 952-233-1632 or info@questcdn.com for assistance in free membership registration, viewing, downloading, and working with this digital project information.

BID SUBMITTAL: A bid shall be submitted online no later than the date and time prescribed. For this project, the Owner will only be accepting online electronic bids through QuestCDN. To access the electronic bid form, download the project document, and click the online bidding button at the top of the advertisement. Prospective bidders must be on the plan holders list through QuestCDN for bids to be accepted.

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BID SECURITY: A Proposal Bond in the amount of not less than 5 percent of the total amount bid, drawn in favor of the City of Spring Valley, shall accompany each bid.

OWNER'S RIGHTS RESERVED: The Owner reserves the right to reject any or all bids and to waive any irregularities and informalities therein and to award the Contract to other than the lowest bidder if, in their discretion, the interest of the Owner would be best served thereby.

DATED: September 14, 2026 **/S/** Deb Zimmer
City Administrator

Published:

Fillmore County Journal: Monday, September 28 and October 5, 2026
QuestCDN: Tuesday, September 29, 2026

******END OF SECTION******

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ARTICLE 1—DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. Issuing Office—The office from which the Bidding Documents are to be issued, and which registers plan holders.

ARTICLE 2—BIDDING DOCUMENTS

2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.

2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.

2.03 Bidder may register as a plan holder and obtain complete sets of Bidding Documents, in the number and format stated in the Advertisement or invitation to bid. Bidders may rely that sets of Bidding Documents obtained in this manner are complete unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.

2.04 Owner is not responsible for omissions in Bidding Documents or other documents obtained from plan rooms or other sources, or for a Bidder's failure to obtain Addenda if they are not a registered plan holder.

2.05 *Electronic Documents*

A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.

1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.05.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

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ARTICLE 3—QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the work, after submitting its Bid and within five (5) days of Owner's request, Bidder must submit the following information:

A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.

B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.

C. Bidder's state or other contractor license number, if applicable.

D. Subcontractor and Supplier qualification information.

E. Other required information regarding qualifications.

3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

ARTICLE 4—PRE-BID CONFERENCE

4.01 A pre-bid conference will not be conducted for this Project.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

5.01 *Site and Other Areas*

A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

5.02 *Existing Site Conditions*

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:

a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.

b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.

c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.

1) Technical Data contained in such reports and drawings.

2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the

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General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

B. *Underground Facilities*: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

5.03 *Other Site-related Documents*

A. In addition to the documents regarding existing Site conditions referred to in Paragraph 5.02.A, the following other documents relating to conditions at or adjacent to the Site are known to Owner and made available to Bidders for reference:

1. No other site related documents are available.

5.04 *Site Visit and Testing by Bidders*

A. Bidder is required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit, the Bidder must not disturb any ongoing operations at the Site.

B. Bidder shall conduct the required Site visit during normal working hours.

C. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

D. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.

E. Bidder must comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

F. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

5.05 *Owner's Safety Program*

A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be noted in the Supplementary Conditions.

5.06 *Other Work at the Site*

A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on

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request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 Express Representations and Certifications in Bid Form, Agreement

A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.

B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.

7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing to the Issuing Office. Contact information and submittal procedures for such questions are as follows: Bolton & Menk, Inc., Office (952) 299-0511; Mobile (763) 334-3876; Email: Lana.Tullis@bolton-menk.com.

7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders. Questions received less than seven days prior to the date for opening of Bids may not be answered.

7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a Bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. Such Bid bond will be issued in the form included in the Bidding Documents or the unmodified EJCDC version of the same form.

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Owner's damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

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ARTICLE 9—CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.

9.02 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND "OR EQUAL" ITEMS

10.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or-equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or-equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.

10.02 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer within 10 days of the issuance of the Advertisement for Bids or invitation to Bidders. Each such request must comply with the requirements of Paragraphs 7.05 and 7.06 of the General Conditions, and the review of the request will be governed by the principles in those paragraphs. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all registered Bidders. Bidders cannot rely upon approvals made in any other manner.

10.03 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

11.02 The apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work within five days after Bid opening:

A. There are no key categories of work.

11.03 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such

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substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

11.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

12.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form must be completed.

B. Paper bids, if applicable, must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form.

C. A Bid price must be indicated for each section, bid item, alternate, adjustment unit price item, and unit price item listed therein.

D. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

12.02 When submitting a paper bid, if Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8½ inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.

12.03 A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.

12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.

12.05 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.

12.06 A Bid by an individual must show the Bidder's name and official address.

12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.

12.08 When submitting a paper bid, all names must be printed in ink below the signatures.

12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.

12.10 Postal and e mail addresses and telephone number for communications regarding the Bid must be shown.

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12.11 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.

12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID

13.01 Lump Sum

A. Bidders must submit a Bid on a lump sum basis as set forth in the Bid Form.

ARTICLE 14—SUBMITTAL OF BID

14.01 The Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 2 of the Bid Form.

14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid. Paper bids, if applicable, must be enclosed in a plainly marked package with the Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the location designated in the Advertisement.

14.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted. Paper bids that are not accepted will be returned to the Bidder unopened.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

15.01 An unopened Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.01 and submit a new Bid prior to the date and time for the opening of Bids.

15.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16—OPENING OF BIDS

16.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. A tabulation of the total amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

17.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

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ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.

18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.

18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.

18.04 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.

18.05 *Evaluation of Bids*

A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

B. For the determination of the apparent low Bidder(s) when alternate(s) are submitted, Bids will be compared on the basis of the sum of the base bid and the alternate(s) selected by the Owner for award.

C. For determination of the apparent low Bidder(s) when sectional bids are submitted, Bids will be compared on the basis of the aggregate of the Bids for separate sections and the Bids for combined sections that result in the lowest total amount for all of the Work.

D. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.

E. For the determination of the apparent low Bidder when cost-plus-fee bids are submitted, Bids will be compared on the basis of the Guaranteed Maximum Price set forth by Bidder on the Bid Form.

18.06 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

18.07 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 19—BONDS AND INSURANCE

19.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.

19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.

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ARTICLE 20—SIGNING OF AGREEMENT

20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 21—SALES AND USE TAXES

21.01 Sales tax is to be included in the Bid.

ARTICLE 22—CONTRACTS TO BE ASSIGNED

22.01 No Supplementary Conditions in this Article.

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Items to Be Submitted with the Bid

for

Wastewater Treatment Facility Improvements

0M2.131536

City of Spring Valley, MN

BID FORMS

Wastewater Treatment Facility Improvements
0M2.131536
City of Spring Valley, Minnesota

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Conditions.

ARTICLE 1—OWNER AND BIDDER

1.01 This Bid is submitted to: City of Spring Valley, 201 South Broadway, Spring Valley, MN 55975. Refer to the Advertisement for Bids for submittal location, format, and deadline for consideration.

1.02 This bid form is provided for Bidders reference. The Bid must be submitted to the City of Spring Valley electronically through QuestCDN.

1.03 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—ATTACHMENTS TO THIS BID

2.01 The following documents are submitted with and made a condition of this Bid:

A. Section 00 41 00 Bid Forms

B. Section 00 43 13 Bid Security Form

C. Section 00 44 00 SAM Documentation

D. Section 00 45 11 Responsible Contractor Verification and Certification of Compliance

E. Signed Paragraph 6.2 "Contract Conditions: BABA" from page 15 of Section 00 92 00 - PFA Contract Packet.

ARTICLE 3—BASIS OF BID

3.01 Lump Sum Bids

A. Bidder will complete the Work in accordance with the Contract Documents for the following lump sum (stipulated) price(s), together with any Unit Prices indicated in Paragraph 3.02:

1. Lump Sum Price (Single Lump Sum)

Lump Sum Bid Price	$

ARTICLE 4—TIME OF COMPLETION

4.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

ARTICLE 5—BIDDER'S ACKNOWLEDGMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

5.01 Bid Acceptance Period

A. This Bid will remain subject to acceptance for 61 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

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5.02 Instructions to Bidders

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

5.03 Receipt of Addenda

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	**Addendum Date**

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 Bidder's Representations

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.

2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

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8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 Bidder's Certifications

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.

3. Bidder has not solicited or induced any individual or entity to refrain from bidding.

4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 6.02.A:

a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.

b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.

d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

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BIDDER hereby submits this Bid as set forth above:

Bidder:

_____

(typed or printed name of organization)

By: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

Address for giving notices:

_____

_____

Bidder's Contact:

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Phone: _____

Email: _____

Address:

_____

_____

_____

Bidder's Contractor License No.: (if applicable) _____

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BID SCHEDULE

Bid Form for construction of:

Wastewater Treatment Facility Improvements
0M2.131536
City of Spring Valley, Minnesota

The undersigned declares that the only persons or parties interested in this Bid as principals are as stated; that the Bid is made without any collusion with other persons, firms, or corporations; that he has carefully examined all the Contract Documents as prepared by Bolton & Menk, Inc.; that he has informed himself fully in regard to all conditions pertaining to the Work and the place where it is to be done, and from them the undersigned makes this Bid. The Bid price covers all expenses incurred in performing the Work required under the Contract Documents, of which this Bid Form is a part.

Note: Bids shall include sales tax and all applicable taxes and fees.

The Bidder has based the following Total Project Base Bid Price upon providing the equipment and materials of the encircled manufacturers as listed in the Equipment/Materials Schedule attached to this Bid Form. Should Bidder fail to indicate which named manufacturer his Total Project Base Bid Price is based upon, the Bidder will supply the first-named manufacturer's equipment/material. Bidder has also indicated substitute equipment/materials that he proposes to be utilized in place of the encircled manufacturers' equipment/materials, subject to the following:

1. Allowance of "alternate" equipment does not constitute a waiver of the Specifications. If the Bidder desires to offer equipment by an "alternate" manufacturer instead of the "Basis of Bid" manufacturer, he shall indicate in the appropriate schedule the change in Lump Sum Base Bid of the "alternate" equipment.

   If a named "alternate" is shown on the bid form, the BIDDER shall indicate a price for installed deduct price. If the BIDDER does not wish to supply a named "alternate" he shall indicate an installed deduct price of zero. If no installed deduct price is listed, the deduct price will be considered to be zero.

   No supporting documents are required for a named alternate. The OWNER reserves the right to accept or reject any or all named "alternates". The named alternates will be taken into consideration in the award of the CONTRACT.

2. In order that the OWNER may determine if the proposed "alternate" manufacturer is a satisfactory substitute to that specified, the bidder shall submit one set of drawings, Specifications, full descriptive material, performance data and a detailed list of exceptions taken to the Specifications with the bid or to the ENGINEER in advance of the bid. Any revisions to structures, piping, mechanical, electrical, instrumentation and control or any other work necessary by such "alternate" equipment must be submitted for approval and the entire cost for such revisions shall be included in the installed price of "alternate."

3. The Engineer will review all proposed "Alternate" Manufacturer's equipment qualification submittals in a timely manner to determine conformance with the performance and technical requirements of this project. The Engineer will be the sole judge as to the comparative quality and suitability of such alternative equipment, products or other materials, and his/her decision shall be final.

4. If awarded a Contract on this project, all equipment items be guaranteed by the undersigned and his Surety to meet the performance requirements of the Contract Documents.

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5. That all installed prices stated on the Equipment/Materials Schedule include the preparation and submittal of detailed drawings showing all modifications, if any, to the Contract Drawing necessary to accommodate such equipment and furthermore that all installed costs stated on the Schedule include complete operating installation, and the furnishing and installing of any and all change or additions in structures, piping, buildings, mechanical and electrical work, accessories and controls, necessary to accommodate the equipment.
6. The naming of a manufacturer in this specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified. All exceptions to the specifications shall be indicated in the shop drawing.

This Proposal is submitted after careful study of the plans and specifications and from personal knowledge of the conditions to be encountered at the project site, which knowledge was obtained from the undersigned's own sources of information and not from any official or employee of the City of Spring Valley, Minnesota.

If a discrepancy appears between the written and the numerical, the written words will be used as the quoted price. If an error appears in an extension or the addition of items, the corrected extension or total of the parts shall govern.

In accordance with the above understanding, the undersigned proposes to perform the Work, furnish all materials, and complete the Work in its entirety in the manner and under the conditions required for the Total Project Base Bid, Lump Sum Price listed on the following pages.

BID of _____

(Name of Bidder)

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Schedule of Prices for Construction of:

Wastewater Treatment Facility Improvements
0M2.131536
City of Spring Valley, Minnesota

Bidder agrees to perform all of the work described in the CONTRACT DOCUMENTS for the following lump sum:

NOTE: BIDS shall include sales tax and all applicable taxes and fees.

The CONTRACTOR shall include in the lump sum bid a construction allowance as specified in Section 01 21 00 - Allowances. Any portion of this allowance not used at the end of the project shall be returned to the OWNER.

TOTAL PROJECT BASE BID PRICE

1. Construction of all facilities as shown on the Contract Drawings and as specified in the Contract Specifications.

To be completed through QuestCDN.com

$

(**To be completed through QuestCDN.com**

DOLLARS)

DISCLAIMER

The BIDDER is required to submit the Bid Schedule online through QuestCDN.com under the Bid Worksheet tab. The bid schedule provided in this document is for information only. If BIDDER chooses to complete a paper copy, it needs to be downloaded from the Bid Worksheet tab in QuestCDN.com, completed, and uploaded through QuestCDN. If the BIDDER chooses to fill out both the online and paper schedules, the Bid Schedule submitted online through QuestCDN.com under the Bid Worksheet tab shall take precedence.

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EQUIPMENT/MATERIALS SCHEDULE

INSTRUCTIONS

A. Items in the following schedule have been designated as the major equipment and/or material items to be furnished. For each item, the Bidder must indicate which of the named manufacturer's equipment/material he intends to supply and upon which he developed his Total Project Base Bid Price. Such indication should be shown by circling the manufacturer's name.

B. The Bidder shall encircle one, and only one, manufacturer's name for each item in the schedule. Should Bidder fail to indicate which named manufacturer his Total Project Base Bid Price is based upon, the Bidder will supply the first-named manufacturer's equipment/material. The prices for the circled equipment/materials schedule do not have to be furnished with the Bid. The lowest three bidders shall supply the equipment/material prices as requested by the ENGINEER.

C. If the Bidder wishes to supply items by an un-named manufacturer, he may propose a substitute manufacturer and indicate the amount by which his Total Project Base Bid Price may be reduced, if the substitution is acceptable to the OWNER and Engineer. Substitute equipment/materials manufacturers will generally be considered provided that:

   1. The substitute equipment is of equal quality, function and performance to the listed equipment item, and it will perform satisfactorily and continuously. In this case, it will be assumed that the cost to the Contractor, if the equipment proposed to be substituted is accepted, is less than the equipment named in the schedule, and, if the substitution is approved, the contract price shall be reduced a corresponding amount. The cost to be deducted from the Total Project Base Bid Price for acceptable substitute equipment shall be listed in the appropriate space on this equipment schedule.

   2. The equipment or material proposed for substitution is superior in construction and efficiency to that named in the Contract. In this case, there may be no Total Project Base Bid Price reduction shown (indicated by a price of zero).

   3. No substitute equipment will be considered unless, in the opinion of the OWNER, it conforms to the Contract Drawings and Specifications in all respects, except for make and manufacturer and minor details.

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EQUIPMENT/MATERIALS SCHEDULE		
Specification Section and Equipment Item	**Basis of Bid Equipment/Material Item (circle one – if not circled, first item will be used)**	**Name of "Alternate" Manufacturer and Amount of Deduct for "Alternate" Manufacturer**
13 34 13 Glass Fiber Reinforced Tank Covers	Enduro Composites Strongwell Midwestern Fabricators	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
13 34 23 Circular Tank Covers	Tank Connection CST Industries Ultraflote	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
26 24 19 Starters and Motor Control	Allen Bradley Square D Eaton / Cutler-Hammer ABB	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
26 90 02 Control System	Automatic Systems Company In Control Total Control Systems	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
40 05 59 Hydraulic Gates	Fontaine Aquanox Rodney Hunt Co. RW Gate Whipps	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
43 11 33 Blower System	Gardner Denver	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct

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EQUIPMENT/MATERIALS SCHEDULE		
Specification Section and Equipment Item	**Basis of Bid Equipment/Material Item (circle one – if not circled, first item will be used)**	**Name of "Alternate" Manufacturer and Amount of Deduct for "Alternate" Manufacturer**
43 25 00 Submersible Centrifugal Pumps	Flygt	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
43 23 00 Self-Priming Centrifugal Pumps	Gorman Rupp Cornell	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
46 21 13 Mechanical Fine Screen 46 21 73 Screenings Dewatering Press	Parkson Huber	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
46 31 00 Chlorination and Dechlorination Equipment	Hydro-Instruments Wallace & Tiernan	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
46 41 21 Jet Mixing/Aeration System	Fluidyne JetTech Products	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct
46 43 21 Clarifier Equipment – Suction Type Clarifier	Ovivo/Eimco Evoqua/Envirex Walker Process WesTech	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct

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EQUIPMENT/MATERIALS SCHEDULE		
Specification Section and Equipment Item	**Basis of Bid Equipment/Material Item (circle one – if not circled, first item will be used)**	**Name of "Alternate" Manufacturer and Amount of Deduct for "Alternate" Manufacturer**
46 51 21 Coarse Bubble Mixing System and 46 51 33 Fine Pore Membrane Aeration Equipment	Axius Water | EDI SSI Aeration, Inc. Xylem | Sanitaire	1. $ Installed Price Add/Deduct 2. $ Installed Price Add/Deduct

****** END OF SECTION ******

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BID SECURITY FORM

Bidder Name: Address *(principal place of business)*:	**Surety** Name: Address *(principal place of business)*:
Owner Name: City of Spring Valley Address *(principal place of business)*: 201 South Broadway Spring Valley, MN 55975	**Bid** Project *(name and location)*: Wastewater Treatment Facility Improvements - Spring Valley, MN Bid Due Date:
Bond Penal Sum: Date of Bond:	

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

Bidder	Surety
_____ *(Full formal name of Bidder)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature) (Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title:	Title:

Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.

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1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation will be null and void if:

    3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

    3.2. All Bids are rejected by Owner, or

    3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.

6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

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SECTION 00 44 00 – SAM DOCUMENTATION

PART 1 -- REQUIREMENTS

A. Go to the site https://www.sam.gov. Go to Search Records then under Quick Search, type in Bidder's name, Search. On the bottom of the search results page, click "Save PDF" and then print out the form indicating that the bidder is not debarred from working on Federal projects.

B. The search results are to be submitted with the Bid per Article 15 of Section C-200 - Instructions to Bidders for Construction Contracts, and made a condition of this Bid.

****** END OF SECTION ******

RESPONSIBLE CONTRACTOR VERIFICATION AND CERTIFICATION OF COMPLIANCE

PRIME CONTRACTOR BID FORM ATTACHMENT

PROJECT NUMBER: 0M2.131536

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 bid form submitted for this project. A bid form received without this form, may 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)	The Contractor: (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)	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, 181.03, 181.101, 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: (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;*

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(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**.

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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 certify 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.

******END OF SECTION******

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Items to Be Executed After Bid Opening

for

Wastewater Treatment Facility Improvements

0M2.131536

City of Spring Valley, MN

BIDDER'S QUALIFICATIONS

GENERAL INFORMATION

The low bidder is requested to furnish the following information. Additional sheets shall be attached as required.

Contractor's name and address: _____

_____

_____

Number of years as a Contractor in construction work of this type: _____

Names and titles of all officers of Contractor's firm: _____

SUBMIT a list of three construction contracts completed by the Contractor during the last five years involving work of similar type and comparable value. The list shall include the following information as a minimum:

- Name, address, and telephone number of owner.
- Name of project.
- Location of project.
- Brief description of the work involved.
- Contract amount.
- Date of completion of contract.
- Name, address and telephone number of architect or engineer.
- Name of owner's project engineer.

EQUIPMENT/MATERIAL SOURCE INFORMATION

The low bidder is requested to list the name of the manufacturer or supplier and catalog numbers of the equipment or material proposed to be furnished under the bid. Awarding of a contract under this bid will not imply approval by the Owner of the manufacturers or suppliers listed by the low bidder.

- As requested by Owner.

******END OF SECTION******

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NOTICE OF AWARD

Date of Issuance:

Owner:	City of Spring Valley	Owner's Project No.:	
Engineer:	Bolton & Menk, Inc.	Engineer's Project No.:	0M2.131536
Project:	Wastewater Treatment Facility Improvements		
Contract Name:	Spring Valley Wastewater Treatment Facility Improvements		
Bidder:			
Bidder's Address:			

You are notified that Owner has accepted your Bid dated _____ for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

- Wastewater Treatment Facility Improvements

The Contract Price of the awarded Contract is $_____. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

_____ unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award or has been transmitted or made available to Bidder electronically.

☐ Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner [number of copies sent] counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Deliver to Owner executed Section 00 51 11 "ADDITIONAL SUBCONTRACTORS LIST" in accordance with Minn. Stat. 16C.285 subd.3 Subclauses (1) to (7). Delivery is a condition precedent to execution of this contract and failure to submit this form shall be cause for the Owner to cancel Award of Contract and declare your Bid security forfeited.
4. Other conditions precedent (if any): [Describe other conditions that require Successful Bidder's compliance]

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: City of Spring Valley

By *(signature)*: _____

Name *(printed)*: Deb Zimmer

Title: City Clerk/Treasurer

Copy: Engineer

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RESPONSIBLE CONTRACTOR VERIFICATION AND CERTIFICATION OF COMPLIANCE
ATTACHMENT A-1
FIRST-TIER SUBCONTRACTORS LIST

SUBMIT PRIOR TO EXECUTION OF A CONSTRUCTION CONTRACT
PROJECT NUMBER: 0M2.131536

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 certify 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:	

ADDITIONAL SUBCONTRACTORS LIST
ATTACHMENT A-2
ADDITIONAL SUBCONTRACTORS LIST

PRIME CONTRACTOR TO SUBMIT AS SUBCONTRACTORS ARE ADDED TO THE PROJECT
PROJECT NUMBER: 0M2.131536

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 certify 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:	

AGREEMENT FORMS

This Agreement is by and between City of Spring Valley ("Owner") and _____ ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

1. Main lift station and forcemain improvements.
2. Renovation of the existing pretreatment building and replacement of mechanical fine screen equipment.
3. Biological treatment renovations, including concrete basin modifications, new aeration and mixing equipment, new clarifiers and control structures, and submersible pumping.
4. Chemical feed improvements, including replacement of gaseous chlorine and sulfur dioxide equipment and installation of new carbon feed.
5. Construction of a new effluent re-aeration system, including precast structure, positive displacement blower, and aeration equipment.
6. Renovations of the existing aerated solids storage facilities, including new coarse bubble mixing improvements, sludge pumping, and sludge loadout.
7. Renovation to other existing buildings, including the disinfection, digestion, and administration buildings. Construction of a new masonry building for electrical equipment.
8. Decommissioning and demolition of existing processes as required.
9. Site work, utility, and pavement improvements.
10. Electrical, instrumentation, control, and SCADA system improvements.

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows:

- City of Spring Valley, MN - Wastewater Treatment Facility Improvements.

ARTICLE 3—ENGINEER

3.01 The Owner has retained Bolton & Menk, Inc. ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

3.02 The part of the Project that pertains to the Work has been designed by Bolton & Menk, Inc.

ARTICLE 4—CONTRACT TIMES

4.01 Time Is of The Essence

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

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4.02 Substantial Completion

A. Substantial completion shall be defined as:

1. The date when construction is sufficiently complete, so the Wastewater Treatment Facility Improvements are fully operational and in compliance with the Owner's NPDES discharge permit regulations.

4.03 Contract Times: Calendar Days

A. The Work shall be substantially complete within seven-hundred and thirty (730) calendar days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within eight-hundred and twenty (820) calendar days after the date when the Contract Times commence to run.

4.04 Liquidated Damages

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner $1,390.00 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.

2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $900.00 for each day that expires after such time until the Work is completed and ready for final payment.

3. Liquidated damages for failing to timely attain completion are not additive and will not be imposed concurrently.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner’s sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 5—CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

A. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item).

B. The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer.

C. For all awarded Work, at the prices stated in Contractor’s Bid, attached hereto as an exhibit.

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D. The Work awarded shall include:

1. Base Bid

2. _____

ARTICLE 6—PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

A. Applications for Payment shall be submitted and processed in accordance with Article 15 of the General Conditions or as modified by the Supplemental Conditions.

6.02 Progress Payments; Retainage

A. Owner shall make progress payments during performance of the work on the basis of Contractor's Applications for Payment dated on or about the 25th day of each month of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

a. 95% percent of the value of the Work completed (with the balance being retainage).

b. 95% percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Within 60 days of the date of Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 99 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 250 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment and all final paperwork is completed. Final paperwork is defined as documents required by the contract which may include but are not limited to:

1. Operations Manuals, record documents, and submittals required by the contract documents, and

2. Payroll documents for projects with prevailing wage requirements, and

3. IC 134, and

4. Lien Releases, if required.

a. Mn Department of Commerce Form 40.5.1.

b. http://www.commerce.state.mn.us/UCB/40.5.1.pdf or equal.

6.03 Progress Payment to Subcontractors

A. For contracts within the State of Minnesota, MN Statute 471.425 Subd. 4a. shall apply. MN Statute 471.425 Subd. 4a. requires:

1. The prime contractor shall pay any subcontractor within ten days of the prime contractor's receipt of payment for undisputed services provided by the subcontractor.

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2. The prime contractor shall pay interest of 1-1/2 percent per month or any part of a month to the subcontractor on any undisputed amount not paid on time to the subcontractor.

3. The minimum monthly interest penalty payment for an unpaid balance of $100 or more is $10. For an unpaid balance of less than $100, the prime contractor shall pay the actual penalty due to the subcontractor.

4. A subcontractor who prevails in a civil action to collect interest penalties from a prime contractor must be awarded its costs and disbursements, including attorney's fees, incurred in bringing the action."

6.04 Final Payment

A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

6.05 Consent of Surety

A. Owner will not make final payment or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.06 Interest

A. All amounts not paid when due will bear interest at the rate of 1.5 percent per month.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 Contents

A. The Contract Documents consist of all the following:

1. This Agreement.

2. Bonds:

a. Performance bond (together with power of attorney).

b. Payment bond (together with power of attorney).

3. General Conditions.

4. Supplementary Conditions.

5. Specifications as listed in the table of contents of the project manual (copy of list attached).

6. Drawings as listed in the table of contents of the project manual (copy of list attached.)

7. Addenda (numbers ___ to ___, inclusive).

8. Exhibits to this Agreement (enumerated as follows):

a. Contractor's Bid (pages ___ to ___, inclusive).

9. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:

a. Notice to Proceed.

b. Work Change Directives.

c. Change Orders.

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d. Field Orders.

e. Warranty Bond, if any.

B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 7.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 Contractor's Representations

A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:

1. Contractor has examined and carefully studied the Contract Documents, including Addenda.

2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

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11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

8.02 Contractor's Certifications

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 Standard General Conditions

A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C 700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

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IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

OWNER:	CONTRACTOR:
City of Spring Valley *(typed or printed name of organization)*	_____ *(typed or printed name of organization)*
By: _____ *(individual's signature)*	By: _____ *(individual's signature)*
Date: _____ *(date signed)*	Date: _____ *(date signed)*
Name: Deb Zimmer *(typed or printed)*	Name: _____ *(typed or printed)*
Title: City Clerk/Treasurer *(typed or printed)*	Title: _____ *(typed or printed)* *(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)*
Attest: _____ *(individual's signature)*	Attest: _____ *(individual's signature)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address for giving notices: 201 South Broadway Spring Valley, MN 55975	Address for giving notices:
Designated Representative:	Designated Representative
Name: _____ *(typed or printed)*	Name: _____ *(typed or printed)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address:	Address:

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NOTICE TO PROCEED

Owner:	City of Spring Valley	Owner's Project No.:	
Engineer:	Bolton & Menk, Inc.	Engineer's Project No.:	0M2.131536
Contractor:		Contractor's Project No.:	
Project:	Wastewater Treatment Facility Improvements		
Contract Name:			
Effective Date of Contract:			

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on _____ pursuant to Paragraph 4.01 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

The Substantial Completion and Final Completion must be achieved in accordance with the requirements of the Agreement.

Before starting any Work at the Site, Contractor must comply with the following: None

Owner: City of Spring Valley

By *(signature)*: _____

Name *(printed)*: Deb Zimmer

Title: City Clerk/Treasurer

Date Issued: _____

Copy: Engineer

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PERFORMANCE BOND FORM

Contractor	**Surety**
Name: Address *(principal place of business)*:	Name: Address *(principal place of business)*:
Owner	**Contract**
Name: City of Spring Valley Mailing address *(principal place of business)*: 201 South Broadway Spring Valley, MN 55975	Description *(name and location):* Wastewater Treatment Facility Improvements - Spring Valley, MN Contract Price: Effective Date of Contract:

Bond

Bond Amount:

Date of Bond:

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

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1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:

    3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;

    3.2. The Owner declares a Contractor Default, terminates the Construction Contract, and notifies the Surety; and

    3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

    5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

    5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

    5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

    5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

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5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

   7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

   7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

   7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

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14.1. Balance of the Contract Price—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2. Construction Contract—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3. Contractor Default—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4. Owner Default—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5. Contract Documents—All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

16. Modifications to this Bond are as follows: None

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PAYMENT BOND FORM

Contractor	**Surety**
Name:	Name:
Address *(principal place of business)*:	Address *(principal place of business)*:
Owner	**Contract**
Name: City of Spring Valley Mailing address *(principal place of business):* 201 South Broadway Spring Valley, MN 55975	Description *(name and location):* Wastewater Treatment Facility Improvements - Spring Valley, MN Contract Price: Effective Date of Contract:

Bond

Bond Amount:

Date of Bond:

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____	_____
(Full formal name of Contractor)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature)(Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

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1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond will arise after the following:

    5.1. Claimants who do not have a direct contract with the Contractor

        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).

    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2. Pay or arrange for payment of any undisputed amounts.

    7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

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8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

    16.1. Claim—A written statement by the Claimant including at a minimum:

        16.1.1. The name of the Claimant;

        16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

        16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

        16.1.4. A brief description of the labor, materials, or equipment furnished;

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16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. Claimant—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3. Construction Contract—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4. Owner Default—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5. Contract Documents—All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

18. Modifications to this Bond are as follows: **None**

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WARRANTY BOND FORM

Contractor	**Surety**
Name: Address (principal place of business):	Name: Address (principal place of business):
Owner	**Construction Contract**
Name: City of Spring Valley Address *(principal place of business)*: 201 South Broadway Spring Valley, MN 55975	Description (name and location): Wastewater Treatment Facility Improvements - Spring Valley, MN Contract Price: Effective Date of Contract: Contract's Date of Substantial Completion:
Bond	
Bond Amount: _____ Date of Bond: _____ Modifications to this Bond form: ☐ None ☐ See Paragraph 9	Bond Period: Commencing 364 days after Substantial Completion of the Work under the Construction Contract, and continuing until two (2) years after such Substantial Completion.

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth herein, do each cause this Warranty Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature) (Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title:	Title:

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

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1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract's Correction Period Obligations. The Construction Contract is incorporated herein by reference.

2. If the Contractor performs the Correction Period Obligations, the Surety and the Contractor shall have no obligation under this Warranty Bond.

3. If Owner gives written notice to Contractor and Surety during the Bond Period of Contractor's obligation under the Correction Period Obligations, and Contractor does not fulfill such obligation, then Surety shall be responsible for fulfillment of such Correction Period Obligations. Surety shall either fulfill the Correction Period Obligations itself, through its agents or contractors, or, in the alternative, Surety may waive the right to fulfill the Correction Period Obligations itself and reimburse the Owner for all resulting costs incurred by Owner in performing Contractor's Correction Period Obligations, including but not limited to correction, removal, replacement, and repair costs.

4. The Surety's liability is limited to the amount of this Warranty Bond. Renewal or continuation of the Warranty Bond will not modify such amount unless expressly agreed to by Surety in writing.

5. The Surety shall have no liability under this Warranty Bond for obligations of the Contractor that are unrelated to the Construction Contract. No right of action will accrue on this Warranty Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

6. Any proceeding, legal or equitable, under this Warranty Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and must be instituted within two years after the Surety refuses or fails to perform its obligations under this Warranty Bond.

7. Written notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown in this Warranty Bond.

8. Definitions

    8.1. Construction Contract—The agreement between the Owner and Contractor identified on the cover page of this Warranty Bond, including all Contract Documents and changes made to the agreement and the Contract Documents.

    8.2. Contract Documents—All the documents that comprise the agreement between the Owner and Contractor.

    8.3. Correction Period Obligations—The duties, responsibilities, commitments, and obligations of the Contractor with respect to correction or replacement of defective Work, as set forth in the Construction Contract's Correction Period clause, EJCDC® C 700, Standard General Conditions of the Construction Contract (2018), Paragraph 15.08, as duly modified.

    8.4. Substantial Completion—As defined in the Construction Contract.

    8.5. Work—As defined in the Construction Contract.

9. Modifications to this Bond are as follows: **None**

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C-700 2018
Standard General Conditions of the Construction Contract

Wastewater Treatment Facility Improvements

0M2.131536

City of Spring Valley, MN

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared By

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GUIDELINES FOR USE OF EJCDC® C-700, STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

1.0 PURPOSE AND INTENDED USE OF THE DOCUMENT

EJCDC® C-700, Standard General Conditions of the Construction Contract (2018), is the foundation document for the EJCDC Construction Series. The General Conditions define the basic rights, responsibilities, risk allocations, and contractual relationship of the Owner and Contractor, and establish how the Contract is to be administered.

2.0 OTHER DOCUMENTS

EJCDC documents are intended to be used as a system and changes in one EJCDC document may require a corresponding change in other documents. Other EJCDC documents may also serve as a reference to provide insight or guidance for the preparation of this document.

These General Conditions have been prepared for use with either EJCDC® C-520, Agreement Between Owner and Contractor for Construction Contract (Stipulated Price), or EJCDC® C-525, Agreement Between Owner and Contractor for Construction Contract (Cost-Plus-Fee) (2018 Editions). The provisions of the General Conditions and the Agreement are interrelated, and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC® C-800, Supplementary Conditions of the Construction Contract (2018).

The full EJCDC Construction series of documents is discussed in the EJCDC® C-001, Commentary on the 2018 EJCDC Construction Documents (2018).

3.0 ORGANIZATION OF INFORMATION

All parties involved in a construction project benefit significantly from a standardized approach in the location of subject matter throughout the documents. Experience confirms the danger of addressing the same subject matter in more than one location; doing so frequently leads to confusion and unanticipated legal consequences. Careful attention should be given to the guidance provided in EJCDC® N-122/AIA® A521, Uniform Location of Subject Matter (2012 Edition) when preparing documents. EJCDC® N-122/AIA® A521 is available at no charge from the EJCDC website, www.ejcdc.org, and from the websites of EJCDC's sponsoring organizations.

If CSI MasterFormat™ is used for organizing the Project Manual, consult CSI MasterFormat™ for the appropriate document number (e.g., under 00 11 00, Advertisements and Invitations), and accordingly number the document and its pages.

4.0 EDITING THIS DOCUMENT

Remove these Guidelines for Use. Some users may also prefer to remove the two cover pages.

Although it is permissible to revise the Standard EJCDC Text of C-700 (the content beginning at page 1 and continuing to the end), it is common practice to leave the Standard EJCDC Text of C-700 intact and unaltered, with modifications and supplementation of C-700's provisions set forth in EJCDC® C-800, Supplementary Conditions of the Construction Contract (2018). If the Standard Text itself is revised, the

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2. During the drafting or negotiating process for C-700, it is important that the two contracting parties are both aware of any changes that have been made to the Standard EJCDC Text. Thus, if a draft or version of C-700 purports to be or appears to be an EJCDC document, the user must plainly show all changes to the Standard EJCDC Text, using "Track Changes" (redline/strikeout), highlighting, or other means of clearly indicating additions and deletions.
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4. Once the document is ready to be finalized (and if applicable executed by the contracting parties), it is no longer necessary to continue to show changes to the Standard EJCDC Text. The user may produce a final version of the document in a format in which all changes are accepted, and the document at that point does not need to include any "Track Changes," redline/strikeout, highlighting, or other indication of additions and deletions to the Standard EJCDC Text.

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

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requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

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recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.

23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.

32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

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33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.

36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.

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43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.

44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

46. *Technical Data*

    a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

48. *Unit Price Work*—Work to be paid for on the basis of unit prices.

49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

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1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*: The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents;

2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

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F. *Contract Price or Contract Times*: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. *Evidence of Contractor's Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

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into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

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ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

A. *Standards Specifications, Codes, Laws and Regulations*

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

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inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

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B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

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established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. Abnormal weather conditions;

3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and

4. Acts of war or terrorism.

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D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.

G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

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B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

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and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

B. *Underground Facilities*: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

C. *Reliance by Contractor on Technical Data*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;

3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or

4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

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5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;

2. is of such a nature as to require a change in the Drawings or Specifications;

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

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Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;

b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

2. complying with applicable state and local utility damage prevention Laws and Regulations;

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3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;

4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. *Engineer's Review*: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

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or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and

c. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

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of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

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conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

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Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

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Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.

F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

H. Contractor shall require:

1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and

2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.

I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

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L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

A. *Required Insurance*: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.

B. *General Provisions*: The policies of insurance required by this Paragraph 6.03 as supplemented must:

1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;

4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and

5. include all necessary endorsements to support the stated requirements.

C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;

2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;

3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

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4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

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Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

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6.06 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

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B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that the proposed item:

1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

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2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) has a proven record of performance and availability of responsive service; and

4) is not objectionable to Owner.

b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

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3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:

    a. will certify that the proposed substitute item will:

        1) perform adequately the functions and achieve the results called for by the general design;

        2) be similar in substance to the item specified; and

        3) be suited to the same use as the item specified.

    b. will state:

        1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;

        2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

        3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

    c. will identify:

        1) all variations of the proposed substitute item from the item specified; and

        2) available engineering, sales, maintenance, repair, and replacement services.

    d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

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H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

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7.09 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

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7.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

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I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Contractor shall:

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

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3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. *Samples*

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

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document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. *Resubmittal Procedures for Shop Drawings and Samples*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.

2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. *Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

   a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

   b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

   c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

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d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03. 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and

2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.

C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer;

2. Recommendation by Engineer or payment by Owner of any progress or final payment;

3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. Use or occupancy of the Work or any part thereof by Owner;

5. Any review and approval of a Shop Drawing or Sample submittal;

6. The issuance of a notice of acceptability by Engineer;

7. The end of the correction period established in Paragraph 15.08;

8. Any inspection, test, or approval by others; or

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9. Any correction of defective Work by Owner.

E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

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D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and

3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

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E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

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B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.

2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

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9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

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ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

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E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

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ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

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B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

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1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:

1. A mutually acceptable fixed fee; or

2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;

b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;

c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and

f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

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11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

    a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

    b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

    The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

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Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

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and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

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2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.

5. Other costs consisting of the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

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consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.

3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

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g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

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Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

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thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

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

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

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D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

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losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

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

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

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or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

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establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

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4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work;

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;

    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

    e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

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b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

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submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

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significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

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d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

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appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;
2. correct such defective Work;
3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

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attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

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provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

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18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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C-800 2018
Supplementary Conditions
of the Construction Contract

Wastewater Treatment Facility Improvements

0M2.131536

City of Spring Valley, MN

Supplementary Conditions of the Construction Contract

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C 700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, “Paragraph SC-4.05.”

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

SC-1.01.A.33 Insert the following sentence at the end of Paragraph 1.01.A.33:

The term Construction Project Representative (CPR) shall have the same meaning as RPR.

SC-1.01.A.42. Delete Paragraph 1.01.A.42 in its entirety and insert the following in its place:

42. Substantial Completion – Substantial Completion shall be as defined in the Agreement.

ARTICLE 2—PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

SC-2.01 Delete Paragraphs 2.01.B. and C. in their entirety and insert the following in their place:

B. Evidence of Contractor’s Insurance: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

C. Evidence of Owner’s Insurance: After receipt from Contractor of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor copies of the policies of insurance to be provided by Owner in this Contract (if any). Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

2.02 Copies of Documents

SC-2.02 Amend the first sentence of Paragraph 2.02.A. to read as follows:

A. Owner shall furnish to Contractor four printed copies of the Contract Documents (including one fully signed counterpart of the Agreement), and one in electronic portable document format (PDF).

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2.06 Electronic Transmittals

SC-2.06 Delete Paragraphs 2.06.B and 2.06.C in their entirety and insert the following in their place:

B. Electronic Documents Protocol: The parties shall conform to the following provisions in Paragraphs 2.06.B and 2.06.C, together referred to as the Electronic Documents Protocol ("EDP" or "Protocol") for exchange of electronic transmittals.

1. Basic Requirements

a. To the fullest extent practical, the parties agree to and will transmit and accept Electronic Documents in an electronic or digital format using the procedures described in this Protocol. Use of the Electronic Documents and any information contained therein is subject to the requirements of this Protocol and other provisions of the Contract.

b. The contents of the information in any Electronic Document will be the responsibility of the transmitting party.

c. Electronic Documents as exchanged by this Protocol may be used in the same manner as the printed versions of the same documents that are exchanged using non-electronic format and methods, subject to the same governing requirements, limitations, and restrictions, set forth in the Contract Documents.

d. Except as otherwise explicitly stated herein, the terms of this Protocol will be incorporated into any other agreement or subcontract between a party and any third party for any portion of the Work on the Project, or any Project-related services, where that third party is, either directly or indirectly, required to exchange Electronic Documents with a party or with Engineer. Nothing herein will modify the requirements of the Contract regarding communications between and among the parties and their subcontractors and consultants.

e. When transmitting Electronic Documents, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the receiving party's use of software application packages, operating systems, or computer hardware differing from those established in this Protocol.

f. Nothing herein negates any obligation 1) in the Contract to create, provide, or maintain an original printed record version of Drawings and Specifications, signed, and sealed according to applicable Laws and Regulations; 2) to comply with any applicable Law or Regulation governing the signing and sealing of design documents or the signing and electronic transmission of any other documents; or 3) to comply with the notice requirements of Paragraph 18.01 of the General Conditions.

2. System Infrastructure for Electronic Document Exchange

a. Each party will provide hardware, operating system(s) software, internet, e-mail, and large file transfer functions ("System Infrastructure") at its own cost and sufficient for complying with the EDP requirements. With the exception of minimum standards set forth in this EDP, and any explicit system requirements

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specified by attachment to this EDP, it is the obligation of each party to determine, for itself, its own System Infrastructure.

1) The maximum size of an email attachment for exchange of Electronic Documents under this EDP is 5 MB. Attachments larger than that may be exchanged using large file transfer functions or physical media.

2) Each Party assumes full and complete responsibility for any and all of its own costs, delays, deficiencies, and errors associated with converting, translating, updating, verifying, licensing, or otherwise enabling its System Infrastructure, including operating systems and software, for use with respect to this EDP.

b. Each party is responsible for its own system operations, security, back-up, archiving, audits, printing resources, and other Information Technology ("IT") for maintaining operations of its System Infrastructure during the Project, including coordination with the party's individual(s) or entity responsible for managing its System Infrastructure and capable of addressing routine communications and other IT issues affecting the exchange of Electronic Documents.

c. Each party will operate and maintain industry-standard, industry-accepted, ISO standard, commercial-grade security software and systems that are intended to protect the other party from: software viruses and other malicious software like worms, trojans, adware; data breaches; loss of confidentiality; and other threats in the transmission to or storage of information from the other parties, including transmission of Electronic Documents by physical media such as CD/DVD/flash drive/hard drive. To the extent that a party maintains and operates such security software and systems, it shall not be liable to the other party for any breach of system security.

d. In the case of disputes, conflicts, or modifications to the EDP required to address issues affecting System Infrastructure, the parties shall cooperatively resolve the issues; but, failing resolution, the Owner is authorized to make and require reasonable and necessary changes to the EDP to effectuate its original intent. If the changes cause additional cost or time to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in price or time under the appropriate process in the Contract.

e. Each party is responsible for its own back-up and archive of documents sent and received during the term of the contract under this EDP, unless this EDP establishes a Project document archive, either as part of a mandatory Project website or other communications protocol, upon which the parties may rely for document archiving during the specified term of operation of such Project document archive. Further, each party remains solely responsible for its own post-Project back-up and archive of Project documents after the term of the Contract, or after termination of the Project document archive, if one is established, for as long as required by the Contract and as each party deems necessary for its own purposes.

f. If a receiving party receives an obviously corrupted, damaged, or unreadable Electronic Document, the receiving party will advise the sending party of the incomplete transmission.

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g. The parties will bring any non-conforming Electronic Documents into compliance with the EDP. The parties will attempt to complete a successful transmission of the Electronic Document or use an alternative delivery method to complete the communication.

C. Software Requirements for Electronic Document Exchange; Limitations

1. Each party will acquire the software and software licenses necessary to create and transmit Electronic Documents and to read and to use any Electronic Documents received from the other party (and if relevant from third parties), using the software formats required in this section of the EDP.

a. Prior to using any updated version of the software required in this section for sending Electronic Documents to the other party, the originating party will first notify and receive concurrence from the other party for use of the updated version or adjust its transmission to comply with this EDP.

2. The parties agree not to intentionally edit, reverse engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes any Electronic Document or information contained therein that was transmitted in a software data format, including Portable Document Format (PDF), intended by sender not to be modified, unless the receiving party obtains the permission of the sending party or is citing or quoting excerpts of the Electronic Document for Project purposes.

3. Software and data formats for exchange of Electronic Documents will conform to the requirements set forth in Exhibit A to this EDP, including software versions, if listed.

SC-2.06 Supplement Paragraph 2.06 of the General Conditions by adding the following paragraph:

D. Requests by Contractor for Electronic Documents in Other Formats

1. Release of any Electronic Document versions of the Project documents in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be at the sole discretion of the Owner.

2. To extent determined by Owner, in its sole discretion, to be prudent and necessary, release of Electronic Documents versions of Project documents and other Project information requested by Contractor ("Request") in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be subject to the provisions of the Owner's response to the Request, and to the following conditions to which Contractor agrees:

a. The content included in the Electronic Documents created by Engineer and covered by the Request was prepared by Engineer as an internal working document for Engineer's purposes solely and is being provided to Contractor on an "AS IS" basis without any warranties of any kind, including, but not limited to any implied warranties of fitness for any purpose. As such, Contractor is advised and acknowledges that the content may not be suitable for Contractor's application or may require substantial modification and independent verification by Contractor. The content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications,

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undocumented intermediate revisions, and other devices that may affect subsequent reuse.

b. Electronic Documents containing text, graphics, metadata, or other types of data that are provided by Engineer to Contractor under the request are only for convenience of Contractor. Any conclusion or information obtained or derived from such data will be at the Contractor's sole risk and the Contractor waives any claims against Engineer or Owner arising from use of data in Electronic Documents covered by the Request.

c. Contractor shall indemnify and hold harmless Owner and Engineer and their subconsultants from all claims, damages, losses, and expenses, including attorneys' fees and defense costs arising out of or resulting from Contractor's use, adaptation, or distribution of any Electronic Documents provided under the Request.

d. Contractor agrees not to sell, copy, transfer, forward, give away or otherwise distribute this information (in source or modified file format) to any third party without the direct written authorization of Engineer, unless such distribution is specifically identified in the Request and is limited to Contractor's subcontractors. Contractor warrants that subsequent use by Contractor's subcontractors complies with all terms of the Contract Documents and Owner's response to Request.

3. In the event that Owner elects to provide or directs the Engineer to provide to Contractor any Contractor-requested Electronic Document versions of Project information that is not explicitly identified in the Contract Documents as being available to Contractor, the Owner shall be reimbursed by Contractor on an hourly basis (at $150 per hour) for any engineering costs necessary to create or otherwise prepare the data in a manner deemed appropriate by Engineer.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 Intent

No Supplementary Conditions in this Article.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.03 Reference Points

4.03.A. Delete Paragraph 4.03.A of the General Conditions in its entirety and insert the following Paragraph 4.03.A in its place:

A. The OWNER will provide engineering surveys to establish reference points for construction.

4.05 Delays in Contractor's Progress

SC-4.05 Amend Paragraph 4.05.C by adding the following subparagraphs:

5. Weather-Related Delays

a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been

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reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled.

b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following:

1) Contractor shall anticipate the number of foreseeable bad weather days per month indicated in the Table 1803-2—Anticipated Work Days Lost Due to Weather in MnDOT Standard Specifications for Construction. The days in Table 1803-2 are cumulative and the number of allowable bad weather days will be determined by totaling the monthly number of days throughout the specified Contract Time. The days in Table 1803-2 will prorated when Contract Time starts or ends mid-month.

2) Work days lost to inclement weather exceeding the allowable number, established as described in Paragraph 4.05.C.2 will be considered as "abnormal weather conditions." The existence of abnormal weather conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by abnormal weather are specific to the planned work activities or that such activities thus delayed were on Contractor's then-current Progress Schedule's critical path for the Project.

3) The Owner will not consider weekends or holidays, as eligible for extensions of Contract Time due to weather unless the Engineer or Owner directs the Contractor to work those days, or the Contractor's accepted progress schedule in place at the time the delay occurred indicated that the Contractor intended to perform Critical Path Work on those days.

ARTICLE 5—SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.03 Subsurface and Physical Conditions

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Design Phase Geotechnical Evaluation	July 2, 2024	Data contained in boring logs, recorded measurements of subsurface water levels, and other factual, objective information regarding conditions at the Site.

F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely:

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Drawings Title	Date of Drawings	Technical Data
There are no drawings the Contractor may rely.		

G. Refer to Appendix A for a copy of the Geotechnical Evaluation report.

5.06 Hazardous Environmental Conditions

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Report Title	Date of Report	Technical Data
There are no reports the Contractor may rely.		

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
There are no drawings the Contractor may rely.		

5.07 Add the following new section immediately after Section 5.06:

5.07 – *Inadvertent Discoveries*

A. The contractor is cautioned that disturbance of historical objects may be subject to criminal or civil penalties.

B. If potential historic objects are found within the project limits, the Contractor shall:

1. Suspend operations in the immediate area of the discovery and protect from construction operations.

2. Notify the Engineer of the presence of potential historical objects.

3. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

4. Work may be restricted or suspended in the Immediate area of the historical objects for a period not to exceed 72 hours without a Contractor claim for damages. No restrictions or suspension shall be imposed over 72 hours unless agreed by the Contractor and the Owner in writing.

ARTICLE 6—BONDS AND INSURANCE

6.01 Performance, Payment, and Other Bonds

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.A:

1. Required Performance Bond Form: The performance bond that Contractor furnishes will be in the form of EJCDC® C 610, Performance Bond (2010, 2013, or 2018 edition).

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2. Required Payment Bond Form: The payment bond that Contractor furnishes will be in the form of EJCDC® C 615, Payment Bond (2010, 2013, or 2018 edition).

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.B:

1. The correction period specified as one year after the date of Substantial Completion in Paragraph 15.08.A of the General Conditions is hereby revised to be 2 years after Substantial Completion.

2. After Substantial Completion, Contractor shall furnish a warranty bond issued in the form of EJCDC® C 612, Warranty Bond (2018). The warranty bond must be in a bond amount of 10 percent of the final Contract Price. The warranty bond period will extend to a date 2 years after Substantial Completion of the Work. Contractor shall deliver the fully executed warranty bond to Owner prior to final payment, and in any event no later than 11 months after Substantial Completion.

3. The warranty bond must be issued by the same surety that issues the performance bond required under Paragraph 6.01.A of the General Conditions.

6.02 Insurance—General Provisions

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.B:

1. Contractor may obtain worker's compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the Project is located, (b) is certified or authorized as a worker's compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker's compensation insurance for similar projects by the state within the last 12 months.

6.03 Contractor's Insurance

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:

D. Other Additional Insureds: As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: None

E. Workers' Compensation and Employer's Liability: Contractor shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, United States Longshoreman and Harbor Workers' Compensation Act, Jones Act, stop-gap employer's liability coverage for monopolistic states, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers' Compensation and Related Policies	**Policy limits of not less than:**
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory

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Workers' Compensation and Related Policies	Policy limits of not less than:
Jones Act (if applicable)	
Bodily injury by accident—each accident	Not Applicable
Bodily injury by disease—aggregate	Not Applicable
Employer's Liability	
Each accident	$1,000,000.00
Each employee	$1,000,000.00
Policy limit	$1,000,000.00
Stop-gap Liability Coverage	
For work performed in monopolistic states, stop-gap liability coverage must be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of:	Not Applicable

F. Commercial General Liability—Claims Covered: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
2. damages insured by reasonably available personal injury liability coverage, and
3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

G. Commercial General Liability—Form and Content: Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.
    a. Such insurance must be maintained for three years after final payment.
    b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
4. Underground, explosion, and collapse coverage.
5. Personal injury coverage.
6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.

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7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

H. Commercial General Liability—Excluded Content: The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).

2. Any exclusion for water intrusion or water damage.

3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.

4. Any exclusion of coverage relating to earth subsidence or movement.

5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).

6. Any limitation or exclusion based on the nature of Contractor's work.

7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. Commercial General Liability—Minimum Policy Limits

Commercial General Liability	**Policy limits of not less than:**
General Aggregate	$2,000,000.00
Products—Completed Operations Aggregate	$2,000,000.00
Personal and Advertising Injury	$1,500,000.00
Bodily Injury and Property Damage—Each Occurrence	$1,500,000.00

J. Automobile Liability: Contractor shall purchase and maintain automobile liability insurance for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy must be written on an occurrence basis.

Automobile Liability	**Policy limits of not less than:**
Bodily Injury	
Each Person	$1,000,000.00
Each Accident	$1,000,000.00
Property Damage	
Each Accident	$1,000,000.00
[or]	
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	$1,000,000.00

K. Umbrella or Excess Liability: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The

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coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	Optional
General Aggregate	Optional

L. Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements: Contractor may meet the policy limits specified for employer's liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of $0 after accounting for partial attribution of its limits to underlying policies, as allowed above.

M. Contractor's Pollution Liability Insurance: Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance must be maintained for no less than three years after final completion.

Contractor's Pollution Liability	Policy limits of not less than:
Each Occurrence/Claim	Not Applicable
General Aggregate	Not Applicable

N. Contractor's Professional Liability Insurance: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor's Professional Liability	Policy limits of not less than:
Each Claim	Not Applicable
Annual Aggregate	Not Applicable

O. Railroad Protective Liability Insurance: No Supplementary Conditions in this Article.

P. Unmanned Aerial Vehicle Liability Insurance: No Supplementary Conditions in this Article.

Q. Other Required Insurance: No Supplementary Conditions in this Article.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.03 Labor; Working Hours

SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be 7:00 A.M. to 7:00 P.M. Monday - Friday.

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2. Owner's legal holidays are: New Year's Day, January 1; Martin Luther King's Birthday, the third Monday in January; Washington's and Lincoln's Birthday, the third Monday in February; Memorial Day, the last Monday in May; Juneteenth, June 19; Independence Day, July 4; Labor Day, the first Monday in September; Christopher Columbus Day, the second Monday in October; Veterans Day, November 11; Thanksgiving Day, the fourth Thursday in November; and Christmas Day, December 25.

3. When a legal holiday occurs on Sunday, the subsequent Monday shall be the observed holiday. When a legal holiday occurs on Saturday, the preceding Friday shall be the observed holiday.

7.12 Record Documents

SC-7.12 Add the following new paragraphs immediately after Paragraph 7.12.A:

A. Supplementary sketches, service record forms, and photographs shall be included to clearly indicate all work as constructed.

1. A blank service record form will be supplied by the Engineer to be used by the Contractor. The Contractor shall fill out a service record form for each water service and sanitary sewer service connection or stub out.

2. The Contractor shall take photographs of underground construction before backfilling. Examples of information to document include connections to existing utilities, watermain fittings, private underground utilities, utility stub-outs, manholes, water, and sanitary sewer connections at the main and the tie-in or stub-out locations.

B. Sanitary and water service tie-in or stub-out locations shall show station and distances left or right of the survey control centerline. Existing sanitary and water service piping material type and size at the tie-in locations shall be noted.

C. All manholes, watermain bends, and valves shall be located with tie-off dimensions to known items on the plans or in the field to enable the Contractor or City personnel to locate these structures for adjustment.

D. The complete set of the record documents shall be submitted to the Engineer prior to the submittal of the final Application for Payment. Failure of the Contractor to maintain an up-to-date set of record drawings on the project site shall be a reason to withhold payments.

ARTICLE 8—OTHER WORK AT THE SITE

Coordination - No Supplementary Conditions in this Article.

ARTICLE 9—OWNER'S RESPONSIBILITIES

Owner's Site Representative. No Supplementary Conditions in this Article.

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ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.03 Resident Project Representative

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.B:

C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:

1. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.

2. Safety Compliance: Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.

3. Liaison

   a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

   b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-site operations.

   c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.

4. Review of Work; Defective Work

   a. Conduct on-site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02 if the Work is in general proceeding in accordance with the Contract Documents.

   b. Observe whether any Work in place appears to be defective.

   c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection, or approval.

5. Inspections and Tests

   a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.

   b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.

6. Payment Requests: Review Applications for Payment with Contractor.

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7. Completion

    a. Participate in Engineer's visits regarding Substantial Completion.

    b. Assist in the preparation of a punch list of items to be completed or corrected.

    c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work and prepare a final punch list of items to be completed or corrected by Contractor.

    d. Observe whether items on the final punch list have been completed or corrected.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of construction.

5 Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.

7. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11—CHANGES TO THE CONTRACT

SC-11.02.C Insert the following after 11.02.B

C. In complying with any Minnesota Governmental Data Practices Act (MGDPA) request, Contractor will be reimbursed by Change Order only for its reasonable direct labor and other direct expenses, without mark-up or increase in 11.07.C. Fee; but only to the extent that the request is not due to a negligent, intentional, or willful act or omission by the Contractor or other failure to comply with its obligations under this contract.

ARTICLE 12—CLAIMS

No Supplementary Conditions in this Article.

ARTICLE 13—COST OF WORK; ALLOWANCES, UNIT PRICE WORK

SC-13.01 Supplement Paragraph 13.01.C.2 by adding the following definition of small tools and hand tools:

a. For purposes of this paragraph, "small tools and hand tools" means any tool or equipment whose current price if it were purchased new at retail would be less than $500.

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13.03 Unit Price Work

SC-13.03 Delete Paragraph 13.03.E in its entirety and insert the following in its place:

E. Adjustments in Unit Price

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the extended price of a particular item of Unit Price Work amounts to five percent or more of the Contract Price and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than twenty percent from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

No Supplementary Conditions in this Article.

ARTICLE 15—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

SC-15.01.D Delete Paragraph 15.01.D.1 in its entirety and replace with the following:

1. The time period for payment shall be in accordance with the Agreement.

SC-15.01.E.1 Add the following new Paragraph 15-01.E.1.m

m. All out-of-state contractors shall comply with all State of Minnesota surety deposit requirements. The OWNER may withhold an additional sum of 8 percent of the amount due the CONTRACTOR from each payment and forward it to the Department of Revenue until the CONTRACTOR's state tax obligations are considered fulfilled unless the CONTRACTOR can show reason for exemption. Exemption will be granted provided the out-of-state CONTRACTOR meets the exemption guidelines established for the Minnesota Department of Revenue. All necessary forms may be obtained from the Minnesota Department of Revenue, Mail Station 4450, St. Paul, Minnesota 55146-4450, or phone 1-800-657-3777 or online at:
http://www.revenue.state.mn.us/businesses/withholding/Pages/Forms.aspx.

SC-15.01 Add the following new Paragraph 15.01.F:

F. For contracts in which the Contract Price is based on the Cost of Work, if Owner determines that progress payments made to date substantially exceed the actual progress of the Work (as measured by reference to the Schedule of Values), or present a potential conflict with the Guaranteed Maximum Price, then Owner may require that Contractor

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prepare and submit a plan for the remaining anticipated Applications for Payment that will bring payments and progress into closer alignment and take into account the Guaranteed Maximum Price (if any), through reductions in billings, increases in retainage, or other equitable measures. Owner will review the plan, discuss any necessary modifications, and implement the plan as modified for all remaining Applications for Payment.

15.03 Substantial Completion

SC-15.03.A. Delete Paragraph 15.03.A. in its entirety and replace with the following:

A. When Contractor considers the entire Work to be substantially complete Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

SC-15.03.B. Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

15.06 Final Payment

SC-15.06 Add the following Paragraph 15.06.A.4. Immediately following Paragraph 15.06.A.3.

4. Final payment will not be made to the CONTRACTOR until a certificate showing that the CONTRACTOR has complied with the provisions of M.S.A. 290.92 requiring withholding of income tax on wages at the source. Said certificate shall be executed by the Commissioner of Revenue. Forms for certification may be obtained from the Commissioner of Revenue, Centennial Building, St. Paul, Minnesota 55145.

15.08 Correction Period

SC-15.08 Add the following new Paragraph 15.08.G:

G. The correction period specified as one year after the date of Substantial Completion in Paragraph 15.08.A of the General Conditions is hereby revised to be the number of years set forth in SC-6.01.B.1; or if no such revision has been made in SC-6.01.B, then the correction period is hereby specified to be 2 years after Substantial Completion.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No Supplementary Conditions in this Article.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

No Supplementary Conditions in this Article.

ARTICLE 18—MISCELLANEOUS

No Supplementary Conditions in this Article.

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EXHIBIT A —SOFTWARE REQUIREMENTS FOR ELECTRONIC DOCUMENT EXCHANGE

Item	Electronic Documents	Transmittal Means	Data Format	Note (1)
a.1	General communications, transmittal covers, meeting notices and responses to general information requests for which there is no specific prescribed form.	Email	Email	
a.2	Meeting agendas, meeting minutes, RFI's and responses to RFI's, and Contract forms.	Email w/ Attachment	PDF	(2)
a.3	Contactor's Submittals (Shop Drawings, "or equal" requests, substitution requests, documentation accompanying Sample submittals and other submittals) to Owner and Engineer, and Owner's and Engineer's responses to Contractor's Submittals, Shop Drawings, correspondence, and Applications for Payment.	Email w/ Attachment	PDF	
a.4	Correspondence; milestone and final version Submittals of reports, layouts, Drawings, maps, calculations and spreadsheets, Specifications, Drawings and other Submittals from Contractor to Owner or Engineer and for responses from Engineer and Owner to Contractor regarding Submittals.	Email w/ Attachment or LFE	PDF	
a.5	Layouts and drawings to be submitted to Owner for future use and modification.	Email w/ Attachment or LFE	DWG	
a.6	Correspondence, reports, and Specifications to be submitted to Owner for future word processing use and modification.	Email w/ Attachment or LFE	DOC	
a.7	Spreadsheets and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	EXC	
a.8	Database files and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	DB	
a.9	Construction photographs	Email w/ Attachment or LFE	JPG	(3)

Notes	
(1)	All exchanges and uses of transmitted data are subject to the appropriate provisions of Contract Documents.
(2)	Transmittal of written notices is governed by Paragraph 18.01 of the General Conditions.
(3)	All photographs must include location details (latitude and longitude) in their metadata.

Key	
Email	Standard Email formats (.htm, .rtf, or .txt). Do not use stationery formatting or other features that impair legibility of content on screen or in printed copies
LFE	Agreed upon Large File Exchange method (FTP, CD, DVD, hard drive)
PDF	Portable Document Format readable by Adobe® Acrobat Reader Version**.**
DWG	Autodesk® AutoCAD .dwg format Version.
DOC	Microsoft® Word .docx format Version.
EXC	Microsoft® Excel .xls or .xml format Version.
DB	Microsoft® Access .mdb format Version.

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PFA CONTRACT PACKET

MINNESOTA
PUBLIC FACILITIES AUTHORITY

BID SOLICITATION CONTRACT PACKET

For projects requiring BABA compliance

For recipients with projects funded through State Fiscal Year 2026 Clean Water and Drinking Water Intended Use Plans that are equivalency projects

Clean Water Revolving Fund
Drinking Water Revolving Fund

This packet and the appropriate federal Davis Bacon and Minnesota prevailing wages requirements must be PHYSICALLY included in all bidding solicitation and contract documents, including subcontracts.

Posted January 2026

Minnesota Public Facilities Authority
1st National Bank Building|332 Minnesota St. Suite W820|Saint Paul, MN 55101-1378
651-259-7469|800-657-3858 TOLL FREE|651-296-8833 FAX| MN.PFA@state.mn.us
An equal opportunity employer and service provider

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1 General Information and Resources

This packet lists required contract conditions that apply to Clean Water and Drinking Water State Revolving Fund (SRF) projects. Equivalency projects are subject to Build America, Buy America (BABA) Act requirements.

Equivalency projects use this Bid Solicitation Contract Packet.

Review this packet prior to bidding. This packet and the appropriate federal Davis Bacon and Minnesota prevailing wages must be physically included in all bidding solicitations and contract documents, including subcontracts.

Use the 2026 Clean Water Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) Applicant Guidance and Information handbook as a resource for this contract packet. The handbook is posted to the MPFA website.

2 General Contract Provisions

2.1 Project Sign and Public Notice Posting

2.1.1 Physical Project Signs

MPFA does not require physical signs for SRF-funded projects.

2.1.2 Clean Water Council Funded Project Signs

Projects funded with Clean Water Funds must comply with funding identification requirements of the Clean Water Council. This applies to CW and DW SRF projects funded with Point Source Implementation Grant (PSIG) program dollars.

2.1.3 Project Funding Notice

MPFA requires posting of funding awards by all recipients. Post the MPFA-provided notice on the Recipient's website or in a public area of their local unit of government offices. Retain the notice in your project files.

2.2 Project Costs

The Recipient acknowledges eligible and ineligible costs as noted below. Travel-related expenses are not reimbursable. They must be built into a contractor's base or employee rates and be directly related to the construction project.

Eligible Costs	Ineligible Costs
Construction and capital costs for items identified in MPCA and MDH project certifications.	Costs associated with seeking, coordinating or securing other financing for the project.
Engineering costs, including planning, design, construction and start-up.	Operation and maintenance of the sewer or water system.
Land costs (see Miscellaneous Administrative Items) and costs associated with complying with the Uniform Act, including appraisals and related legal costs, are eligible costs.	Administrative costs of a board, sanitary district or governmental unit.
Reasonable costs associated with labor standards, BABA and AIS compliance.	Indirect costs.
Legal costs associated with establishment of the revenue stream for repayment of MPFA financing, such as development of sewer/water ordinance and special assessments, or review of construction contracts.	MPCA or MDH permits.
Reasonable costs to set up and implement long-term financial and asset management tools.	Non-capital costs. Travel related costs including mileage, meals, and lodging: Travel related costs can be eligible project costs if they are necessary and directly related to the capital project, but they must be built into the contractor's base or employee hourly rates.
Financing costs directly associated with MPFA financing: bond counsel costs for preparation of General Obligation Bond and	

related documents, limited financial advisor fees for establishing a dedicated source of revenue.	
Eligible Costs-LSLR	**Ineligible Costs-LSLR**
Directly connected to the planning, design, and replacement of lead service lines. Removal of lead or galvanized goosenecks, pigtails, and connectors. Replacement of curb stops, curb stop boxes, and other service line appurtenances that are removed as part of a full LSLR. Site restoration, including landscaping, sidewalks, driveways, etc. if the removal was necessary to replace the lead service line. Reasonable costs associated with labor standards, Build America, Buy American (BABA), and American Iron and Steel compliance. Temporary pitcher filters or point-of-use (POU) devices certified by an American National Standards Institute accredited certifier to reduce lead for a designated period after LSLR replacement is complete. Outreach and engagement activities, including translation services.	Corrosion control activities and measures. Premise/interior plumbing. Water meters. Funding for bottled water.

2.3 Reporting

2.3.1 The Contract Packet

This packet includes information on state and federal laws related to procurement, pre-bid and post bid requirements, required contract language for bid and contract documents and reporting forms.

The proper Contract Packet must be physically incorporated into the bid and contract documents along with the appropriate State and Federal prevailing wage rates. IMPORTANT: The Contractor must provide information to the recipient for required reporting and to document compliance with specific contract conditions such as:

- ☐ Build America, Buy America (unless project qualifies for Adjustment Period Waiver).
- ☐ American Iron & Steel (certifications, letters, de minimis tracking).
- ☐ DBE/M/WBE fair share efforts.
- ☐ Prevailing Wages (both state and federal).

2.3.2 Records

The Recipient must keep all project accounts and records for the MPFA-funded project (water and/or sewer fund) in accordance with Generally Accepted Accounting Principles (GAAP). Financial statements must comply with GASB 34 (Governmental Accounting Standards Board) standards related to the reporting of infrastructure assets.

3 Build America, Buy America (BABA) Act

3.1 BABA Resources

Environmental Protection Agency Guidance and Resources

- Environmental Protection Agency main webpage: Build America, Buy America (BABA) | US EPA
- Environmental Protection Agency BABA De Minimis Waiver: US EPA BABA De Minimis Waiver
- Environmental Protection Agency BABA Minor Components Waiver: Public Interest: Minor Components of Iron and Steel Products Waiver for Build America, Buy America Act (epa.gov)

3.2 Sample Build America, Buy America Contract Language

The BABA language below is a sample from the Environmental Protection Agency's November 3, 2022 memorandum (OW-BABA-Implementation-Procedures-Final-November-2022.pdf (epa.gov)). Include actual BABA language into project specifications and construction contracts and sub-contracts.

Example Build America, Buy America (BABA) Act Construction Contract Language

ALL CONSTRUCTION CONTRACTS MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE BABA REQUIREMENTS. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN A PROJECT'S CONSTRUCTION CONTRACT THAT USE STATE REVOLVING FUNDS (SRF). EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE OR LOCAL LAW:

The Contractor acknowledges to and for the benefit of the _____ ("Owner") and the _____ (the "Funding Authority") that it understands the goods and services under this Agreement are being funded with federal monies and have statutory requirements commonly known as "Build America, Buy America;" that requires all of the iron and steel, manufactured products, and construction materials used in the project to be produced in the United States ("Build America, Buy America Requirements") including iron and steel, manufactured products, and construction materials provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Owner and Funding Authority (a) the Contractor has reviewed and understands the Build America, Buy America Requirements, (b) all of the iron and steel, manufactured products, and construction materials used in the project will be and/or have been produced in the United States in a manner that complies with the Build America, Buy America Requirements, unless a waiver of the requirements is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the Build America, Buy America Requirements, as may be requested by the Owner or the Funding Authority. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Owner or Funding Authority to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Owner or Funding Authority resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the Funding Authority or any damages owed to the Funding Authority by the Owner). If the Contractor has no direct contractual privity with the Funding Authority, as a lender or awardee to the Owner for the funding of its project, the Owner and the Contractor agree that the Funding Authority is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the Funding Authority.

3.3 Build America, Buy America De Minimis Waiver Tracking Form

The Environmental Protection Agency (EPA) granted a national waiver for de minimis components (US EPA BABA De Minimis Waiver) for eligible water infrastructure projects. Products that qualify for a de minimis waiver cumulatively may comprise no more than a total of five percent of the total project cost. Please note the BABA de minimis waiver is not additive to the existing American Iron and Steel national de minimis waiver.

To use the de minimis waiver, SRF recipients "should in consultation with their contractors determine the items to be covered by this waiver and must retain relevant documentation (i.e. invoices) as to those items in their project files." Recipients must maintain documentation (i.e., invoices) for the de minimis items in the project file and submit a summary report to the MPFA at project conclusion, or sooner, if available. An example tracking form for BABA de minimis is included on the next page.

Minnesota State Revolving Funds (CWRF and DWRF)
Use of Build America, Buy America - De Minimis Final Utilization and Certification Form

Use of Build America, Buy America (BABA) is required for CWRF and DWRF-funded projects unless the project qualifed for a waiver. The Environmental Protection Agency has issued a public interest waiver for De Minimis components. The PFA recipient wishing to use this waiver should consult with their contractor(s) to maintain an itemized list of components covered under De Minimis. At the conclusion of the project, this form must be completed and retained in the assistance recipient's project files and a copy provided to the Public Facilities Authority. **It is strongly recommended that you maintain a list as the project progresses**. Please print clearly or type. EPA Deminimis Waiver:

US EPA BABA De Minimis Waiver

PFA Recipient _____ Loan #: _____

Project Name: _____

NOTE: The De Minimis waiver is only applicable to the cost of the total project. Recipients must have sufficient documentation to support all costs included in this calculation. NOTE: the BABA De Minimis waiver is not additive with the existing American Iron and Steel national de minimis waiver.

Funds used for de minimis incidental components cumulatively may comprise no more than a total of 5 percent of the total project cost.

Total Project Cost: _____ 5% Limit: _____

Item or Component Description (Please include model number, part number, etc. to clearly identify item or component)	Quantity (if applicable)	Cost per Unit (if applicable)	Component's Total Cost	How is Cost Documented?*

Use additional sheets as necessary

Total Cost of Components deemed to be De Minimis: _____

If approaching the 5% limit, contact PFA immediately

* Documentation must demonstrate confirmation of the components' actual costs (invoice, etc.).

Completed by:

Name: _____ Title: _____

Signature: _____ Date: _____

3.4 Build America, Buy America Documentation

Contractors must comply with and provide documentation that shows compliance with BABA requirements. Product certifications letters need to include the following five items:

1. Documentation linked to the project. Identify the project name, project location, contract number, or project number.
2. Documentation linked to the product used on the project. Description of product(s) (simple explanation sufficient to identify the product(s)), or an attached (or electronic link to) purchase order, invoice, or bill of lading.
3. Documentation includes statement attesting that the products supplied to the MPFA Recipient are compliant with BABA requirement. Reference to the Infrastructure Investment and Jobs Act (IIJA) or the Bipartisan Infrastructure Law (BIL) are also acceptable. For iron and steel items under BABA, references to the American Iron and Steel (AIS) requirement are also acceptable and reciprocal with BABA for such items.
4. Documentation that manufacturing occurred in the United States, which could include, for example, the location(s) of manufacturing for each manufacturing step that is being certified. It is acceptable for manufactured products to note a single point of manufacturing, documenting that the final point of manufacturing is in the United States. Note that each BABA category may require different determinations for compliance.
5. Signature of company representative (on company letterhead and signature can be electronic). The signatory of the certifying statement affirms their knowledge of the manufacturing processes for the referenced product(s) and attests that the produce meets the BABA requirements.

4 Disadvantaged Business Enterprises (DBE)

EPA issued Recipient/Applicant Information Notice (RAIN) 2025-GO2 immediately suspending major components of its DBE regulations at 40 CFR Part 33 for all EPA awards. The notice suspends requirements for fair share objectives (goals for DBE participation) under 40 CFR Part 33 Subpart D, recipient reporting requirements under 40 CFR 33.502, and compliance and enforcement provisions under 40 CFR Part 33.105 and collection of EPA form 5700-52A as a condition of closeout. The General Term and Condition "Utilization of Disadvantaged Business Enterprises: is revised and applicable to all recipients of EPA funding and supersedes all previously existing DBE terms and conditions.

The following requirements remain in effect:

- Compliance with 40 CFR Part 33 regarding DBE program rules.
- Six good faith efforts (described on in Section 4.1 below).
- Fair share objectives applied to procurements after they are approved.
- Recordkeeping where recipients maintain records related to their DBE utilization efforts, including a bidders list.
- Contract administration provisions.

4.1 Good Faith Efforts

Borrowers and their prime contractors must follow, document, and maintain documentation of their good faith efforts as listed below to ensure that Disadvantage Business Enterprises (DBEs) have the opportunity to participate in the project. This applies to procurement for **construction, equipment, supplies and services.**

The Six Good Faith Efforts:

1. Outreach and Recruitment: Ensure that DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. This includes placing DBEs on solicitation lists and actively soliciting them whenever they are potential sources.
2. Information Availability: Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
3. Subcontracting Considerations: Consider whether firms competing for large contracts could subcontract with DBEs. This may involve dividing total requirements into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.
4. Encourage Consortia: Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually, thereby promoting collaboration among DBEs.
5. Utilizing Assistance Services: Use the services and assistance of the SBA and the U. S. Department of Commerce Minority Business Development Agency to support DBE participation.
6. Replacement Subcontractors: If a DBE subcontractor fails to complete work under the subcontract for any reason, the recipient must require the prime contractor to employ the six good faith efforts when soliciting a replacement subcontractor. These requirements are designed to promote fair competition and ensure DBEs have a meaningful opportunity to participate in federally funded

projects. Recipients must document compliance with these efforts and report their accomplishments to the EPA as part of their obligations under federal law.

4.2 Certified M/WBE Firms

M/WBE firms certified by the Minnesota Unified Certification Program, the SBA, or the US Department of Transportation can be counted towards the M/WBE reporting to MPFA. See "How do I find information on DOT's and SBA's certification programs?"

Frequently Asked Questions for Disadvantaged Business Enterprises | US EPA

US DOT Office of Small and Disadvantaged Business Utilization | US Department of Transportation

Women-Owned Small Business Federal Contract program (sba.gov)

8(a) Business Development program (sba.gov)

Verifying firm M/WBE status: Check the *Minnesota Unified Certification Program Directory* or the *SBA Dynamic Small Business Search Directory*. Links are listed below.

Minnesota Unified Certification Program: http://mnucp.metc.state.mn.us/ includes a free search engine that lists certified DBE contractors and suppliers. Links to this directory are on the MN Department of Transportation website: http://www.dot.state.mn.us/civilrights/

The SBA **Dynamic Small Business Search**: search engine that lists businesses with 8(a) Certifications; Small Disadvantaged Business Certifications; HUBZone Certifications and DBE Certifications. Check contractor detail to see what current certifications are in place. Dynamic Small Business Search can be found at this link https://www.sba.gov/partners/contracting-officials/small-business-procurement under "Finding Contractors".

4.2.1 Other Minority/Women Business Enterprises Resources

- *A*ssociation of Women Contractors http://www.awcmn.org/
- Diversity Information Resources, Inc. www.diversityinforesources.com
- Metropolitan Economic Development Association http://www.meda.net/
- Minority Business Development Agency (U. S. Department of Commerce) http://www.mbda.gov/

4.2.2 Minnesota Targeted Business Vendors (State Funded Projects)

The Minnesota Department of Administration maintains a directory for Targeted Group Economically Disadvantaged and Veteran-Owned (TG/ED/VO) businesses Equity in Procurement (TG/ED/VO) Directory / Minnesota Office of State Procurement (mn.gov). The Environmental Protection Agency does not consider Minnesota Department of Administration TG/ED/VO listings as meeting EPA certification requirements; thus TG/ED/VO vendors cannot be counted as M/WBE vendors by the Environmental Protection Agency. However, state-funded projects are encouraged to consider and provide procurement opportunities to vendors on this list.

5 Federal and State Prevailing Wages

Both Federal Davis Bacon prevailing wages and State of Minnesota prevailing wages (Minnesota Statute, sections 177.41-177.43) apply to MPFA funded projects.. Payment of the wages, fringe benefits and overtime rates that are most beneficial to the employees are required. **All worker classifications must have a state and federal prevailing wage.** Overtime is governed by Minnesota Prevailing Wage Statutes at M.S. 177.42 which requires overtime for over 8 hours per day and for more than 40 hours per week, thus any employee working more than 8 hours in one day is entitled to overtime.

Both the proper Federal (Davis-Bacon) and State of Minnesota Prevailing Wage rates and contract conditions must be physically incorporated into the bidding and contract documents for primary and subcontracts.

Obtain required state posters from the Minnesota Department of Labor and Industry at http://www.dli.mn.gov/about-department/workplace-posters

Obtain federal posters at http://www.dol.gov/whd/regs/compliance/posters/davis.htm

Weekly certified payroll submittal is required under the Federal Davis Bacon laws.

6 Contract Conditions

This project is being financed in whole or in part by the MPFA through the Clean Water or Drinking Water State Revolving Fund. The MPFA recipient is required to comply with certain state and federal laws, rules and regulations and to ensure that their contractor(s) also complies with these laws, regulations, rules, including, but not limited to the items below which will be included in all contracts and subcontracts.

6.1 General Contract Conditions

1. Title VI of the Civil Rights Act of 1964 (P.L 88-352), the Rehabilitation Act of 1973 (P.L. 93-1123, 87 Stat. 355, 29 U.S.C. Sec. 794), the Older Americans Amendments of 1975 (P.L. 94-135 Sec. 303, 89 Stat. 713, 728, 42 U.S.C. Sec. 6102), and subsequent regulations, ensures access to facilities or programs regardless of race, color, national origin, sex, age or handicap.

2. Executive Orders 11625, 12138 and 12432; 40 CFR part 33; Section 129 of P. L. 100-590 Small Businesses Reauthorization & Amendment Act of 1988; Public Law 102-389 (42 U.S.C. 437d); a 1993 appropriations act; Public Law 101-549, Title X of the Clean Air Acts Amendments of 1990 (42 U.S.C. 7601 note). Encourages recipients to award construction, supply and professional service contracts to minority and women's business enterprises (MBE/WBE) and small businesses and requires recipients to utilize affirmative steps in procurement.

3. 40 CFR Part 33 Participation by Disadvantaged Business Enterprises in Procurement under Environmental Protection Agency (EPA) Financial Assistance Agreements.

4. Executive Orders 12549 and 12689, 2 CFR Part 180, and 2 CFR Part 1532, Subparts B and C. Prohibits entering into contracts or sub-contracts with individuals or businesses who are debarred or suspended. Before contracts are awarded, MPFA Recipients are required to check the status of all contractors (construction and professional services) and must require contractors to check the status of subcontractors and suppliers for contracts expected to be equal to or over $25,000 via the U. S. General Services Administration System for Award Management website SAM.gov | Home or search the internet for sam.gov. Also verify the status on the Minnesota Department of Administration's listing: Suspended/Debarred Vendors / Minnesota Office of State Procurement (mn.gov).

5. Section 602(b)(6) of the Federal Water Pollution Control Act, as amended and section 1450(e) of the Safe Drinking Water Act (42 U.S.C. 300j-9(e))require that all laborers and mechanics employed by contractors or subcontractors be paid wages at rates not less than those prevailing for the same type of work as determined by the U. S. Secretary of Labor in accordance with the Davis-Bacon Act (46 Stat. 1494; 40 U.S.C., sec. 276a through 276a-5). Reorganization Plan Number 14 of 1950 (15 F.R. 3176) and section 2 of the Davis-Bacon Act of June 13, 1934, as amended (48 Stat. 948; 40 U.S.C. 276c).

6. Build America, Buy America Act ("the Act"). Pub. L. No. 117-58, §§ 70901-52 requires all the iron and

steel, manufactured products and construction materials used in the CWSRF and DWSRF projects be produced in the United States, unless the MPFA Recipient has requested and obtained a waiver from the EPA pertaining to the products used in the project. Pursuant to Section 70914(c) of the Build America, Buy America Act, EPA may waive Buy America preference where EPA finds that:

a. Applying the domestic content procurement preference would be inconsistent with the public interest (a "public interest waiver");

b. Types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality (a "nonavailability waiver"); or

c. Inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25 percent (an "unreasonable cost waiver").

7. 2 CFR 200.216 Prohibition on certain telecommunications and video surveillance services or equipment (implementing Section 889 of Public Law 115-232).

8. Minnesota Statutes, Section 471.345, Uniform Municipal Contracting Law.

9. Minnesota Statutes, Section 574.26 to 574.32, the Public Contractors' Performance and Payment Bond Act, as applicable

10. Minnesota Statutes sections 176.181-176.182. Requires recipients and subcontractors to have worker's compensation insurance coverage.

11. Minnesota Statutes sections 177.41-177.43 and Minnesota Rules 5200.1000 to 5200.1120 (prevailing wage rate law and rules). Requires that contractors pay laborers and mechanics prevailing wages established by the Minnesota Department of Labor and Industry for public works projects.

12. Minnesota Statutes 290.9705. Requires that 8 percent of payments made to out-of-state contractors be withheld once cumulative payments made to the contractor for work done in Minnesota exceed $50,000 in a calendar year, unless an exemption is granted by the Department of Revenue.

13. Minnesota Statutes, Chapter 16C.285, Responsible Contractor Requirements.

14. Minnesota Statutes Sec. 363A.36, Minnesota Department of Human Rights (MDHR) affirmative action plan requirements for contracts exceeding $250,000. An affirmative action plan and a workforce certificate for affected contractors is required prior to bidding (Apply for a Workforce Certificate / Minnesota.gov (mn.gov)).

15. Minnesota Statutes Section 363A.43, Minnesota Department of Human Rights (MDHR) equal pay certificate. Required for agreements and contracts for goods and services exceeding $1,000,000

with a business that has 40 or more full-time employees in Minnesota or a state where the business has its primary place of business on a single day during the prior 12 months, unless the business has an equal pay certificate, or it has certified in writing that it is exempt.

16. Minnesota Statutes Section 181.59, Discrimination on Account of Race, Creed, or Color Prohibited in Contract.

6.2 Contract Conditions: BABA

The Contractor acknowledges to and for the benefit of the City of **Spring Valley, MN** ("Owner") and the Minnesota Public Facilities Authority (the "Funding Authority") that it understands the goods and services under this Agreement are being funded with federal monies and have statutory requirements commonly known as "Build America, Buy America;" that requires all of the iron and steel, manufactured products, and construction materials used in the project to be produced in the United States ("Build America, Buy America Requirements") including iron and steel, manufactured products, and construction materials provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Owner and Funding Authority (a) the Contractor has reviewed and understands the Build America, Buy America Requirements, (b) all of the iron and steel, manufactured products, and construction materials used in the project will be and/or have been produced in the United States in a manner that complies with the Build America, Buy America Requirements, unless a waiver of the requirements is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the Build America, Buy America Requirements, as may be requested by the Owner or the Funding Authority. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Owner or Funding Authority to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Owner or Funding Authority resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the Funding Authority or any damages owed to the Funding Authority by the Owner). If the Contractor has no direct contractual privity with the Funding Authority, as a lender or awardee to the Owner for the funding of its project, the Owner and the Contractor agree that the Funding Authority is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the Funding Authority.

I certify that I have read the above agreement and certification and agree to adhere to all rules and regulations set forth by the Build America, Buy America (BABA) Requirements.

Date: _____

Signature: _____

Name: _____

Title: _____

Company Name: _____

6.3 Required Contract Conditions: DBE

These conditions must be included in all procurement contracts entered by the Borrower for all DWRF and CWRF projects:

1. The prime contractor must pay its subcontractor for satisfactory performance no more than 30 days from the prime contractor's receipt of payment from the owner.2. The prime contractor must notify the owner in writing prior to the termination of any Disadvantage Business Enterprise subcontractor for convenience by the prime contractor.
3. If a Disadvantage Business Enterprise contractor fails to complete work under the subcontract for any reason, the prime contractor must employ the six good faith efforts if soliciting a replacement contractor.
4. The prime contractor must continue to employ the six good faith efforts even if the prime contractor has achieved its fair share objectives.
5. A Borrower must ensure that each procurement contract it awards contains the following terms and conditions:

> The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

6.4 Required Contract Conditions: Federal Davis Bacon Prevailing Wages

NOTE: Both federal Davis Bacon prevailing wages and State of Minnesota prevailing wages (Minnesota Statute, sections 177.41-177.43) apply to this project. Payment of the wages, fringe benefits and overtime rates that are most beneficial to the employees are required.

Federal posters can be obtained at http://www.dol.gov/whd/regs/compliance/posters/davis.htm

The "recipient" referred to throughout the Davis Bacon contract conditions is the MPFA borrower. The "MPFA" is the Minnesota Public Facilities Authority.

This language must be included in all Davis Bacon covered construction contracts and subcontracts. (29 CFR Part 5.5)

(a) The Recipient shall insert in full in any contract in excess of $2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWRF or a construction project under the DWRF, financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except

where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in Sec. 5.1 the following clauses:

(1) **Minimum wages**. (i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in Sec. 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Recipients may obtain wage determinations from: https://sam.gov/content/wage-determinations.

(ii)(A) The Recipient, on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Recipient's award official shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Recipient agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and

the request, including the local wage determination shall be sent by the Recipient to the Administrator of the Wage and Hour Division, Conformance and CBA Update public email address:

WHD-CBACONFORMANCE_INCOMING@dol.gov and to the EPA DB Regional Coordinator concurrently at (USEPA REGION 5, 77 West Jackson Boulevard Mail Code: MC-10J, Chicago, IL 60604-3507. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Recipient or will notify the Recipient within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the Recipient do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the Recipient's award official, to the Administrator for determination. The request shall be sent to the EPA DB Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside assets in a separate account for the meeting of obligations under the plan or program.

(2) **Withholding**. The Recipient shall upon its own action or upon written request of the MPFA, EPA award official or an authorized representative of the Department of Labor (DOL) withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Recipient may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) **Payrolls and basic records**. (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Recipient. Such documentation shall be available on request of the MPFA or EPA. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), **except that full social security numbers and home addresses shall not be included on weekly payrolls**. Instead, the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 and instructions are available for this purpose from the Wage and Hour Division Web site at WHD | U.S. Department of Labor (dol.gov) or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker and shall provide them upon request to the Recipient for transmission to the MPFA or EPA, if requested by EPA, the MPFA, the contractor, or the Wage and Hour Division of the DOL for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the Recipient.

(B) Each payroll submitted shall be accompanied by a ``Statement of Compliance,'' signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under Sec. 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under Sec. 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the ``Statement of Compliance'' required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the MPFA, EPA or the DOL, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or MPFA may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) **Apprentices and trainees**-(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program

for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the DOL, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of 29 CFR part 30.

(5) **Compliance with Copeland Act requirements**. The contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

(6) **Subcontracts**. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) **Contract termination: debarment**. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) **Compliance with Davis-Bacon and Related Act (DBRA) requirements**. DBRA is a collection of labor standards provisions administered by the DOL applicable to Federal assistance agreements and subawards involving construction. All rulings and interpretations of the DBRA contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) **Disputes concerning labor standards**. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the DOL set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the Recipient, MPFA, EPA, the DOL, or the employees or their representatives.

(10) **Certification of eligibility**. (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(b) **Contract Work Hours and Safety Standards Act**. The Recipient shall insert the following clauses set forth in paragraphs (b)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR Sec. 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) **Overtime requirements.** No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) **Violation; liability for unpaid wages; liquidated damages.** In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the

standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) **Withholding for unpaid wages and liquidated damages.** The Recipient, upon its own action or upon written request of the MPFA, EPA Award Official or an authorized representative of the DOL shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) **Subcontracts.** The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

(c) In addition to the clauses contained in paragraph (b), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR Sec. 5.1, the Recipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Recipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the MPFA, EPA and the DOL, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

6.5 Required Conditions: U. S. DOL Wage and Hour Division Davis-Bacon Prevailing Wages

Under the Davis-Bacon and Related Acts and Reorganization Plan No. 14 of 1950, the DOL is responsible for determining prevailing wages, issuing regulations and standards to be observed by federal agencies that award or fund projects subject to Davis-Bacon labor standards, and overseeing consistent enforcement of the Davis-Bacon labor standards.

The Davis-Bacon and Related Acts apply to contractors and subcontractors performing on federally funded or assisted contracts in excess of $2,000 for the construction, alteration, or repair (including painting and decorating) of public buildings or public works. Davis-Bacon Act and Related Act contractors and subcontractors must pay their laborers and mechanics employed under the contract no less than the locally prevailing wages and fringe benefits for corresponding work on similar projects in the area.

The Davis-Bacon Act directs the DOL to determine such locally prevailing wage rates. The Davis-Bacon Act applies to contractors and subcontractors performing work on federal or District of Columbia contracts. The Davis-Bacon Act prevailing wage provisions apply to the "Related Acts," under which federal agencies assist construction projects through grants, loans, loan guarantees, and insurance.

For prime contracts in excess of $100,000, contractors and subcontractors must also, under the provisions of the Contract Work Hours and Safety Standards Act, as amended, pay laborers and mechanics, including guards and watchmen, at least one and one-half times their regular rate of pay for all hours worked over 40 in a workweek. The overtime provisions of the Fair Labor Standards Act may also apply to DBA-covered contracts.

Insert applicable federal Davis-Bacon Prevailing Wages here

6.6 Required Conditions: State of Minnesota Prevailing Wages

Pursuant to Minnesota Statutes 177.41 to 177.44 and corresponding Minnesota Rules 5200.1000 to 5200.1120, this contract is subject to the prevailing wages as established by the Minnesota Department of Labor and Industry (DOLI). Specifically, all contractors and subcontractors must pay all laborers and mechanics the established prevailing wages for work performed under the contract. Failure to comply with the aforementioned may result in civil or criminal penalties. The applicable wage determination must be incorporated into proposals and all contracts.

Payrolls/Records

The contractor and subcontractor shall furnish to the OWNER copies of any or all payrolls not more than 14 days after the end of each pay period. The payrolls must contain all data required by Minnesota Statutes Section 177.30. Subcontractors must furnish payrolls to the contractor. The OWNER may examine all records relating to wages paid laborers or mechanics on work to which Minnesota Statutes Sections 177.41 to 177.44 apply.

Posting of Wage Rates/Required Posters

Each contractor and subcontractor performing work on a public project shall post on the project the applicable prevailing wage rates and hourly basic rates of pay for the county or area within which the project is being performed, including the effective date of any changes thereof, in at least one conspicuous place for the information of the employees working on the project. The information so posted shall include a breakdown of contributions for health and welfare benefits, vacation benefits, pension benefits, and any other economic benefits required to be paid.

For more information regarding prevailing wage and its application, contact:

Minnesota Department of Labor and Industry
Prevailing Wage unit
443 Lafayette Road North
St. Paul, MN 55155
Phone: (651) 284-5091
E-mail: dli.prevwage@state.mn.us
Web: Prevailing-wage information | Minnesota Department of Labor and Industry (mn.gov)

"General Decision Number: MN20260049 07/30/2026

State: Minnesota

Construction Types: Building

Counties: Minnesota Counties of
Fillmore

Please refer to Minnesota Rules 5200.1100, 5200.1101, and 5200.1102 for definitions of labor classifications on this wage determination, and direct any questions regarding such classifications to the Branch of Construction Wage Determinations.

Modification Number	Publication Date
0	01/02/2026
1	05/18/2026
2	07/30/2026

SAMN2025-001 12/22/2025

	Rates	Fringes
ARTICULATED HAULER	$ 33.00	7.50
ASBESTOS ABATEMENT WORKER	$ 41.23	25.99
BOILERMAKER	$ 46.00	31.93
BOOM TRUCK	$ 48.52	31.00
BRICKLAYER	$ 52.98	28.26
CARPENTER	$ 46.81	27.40
CARPET LAYER (LINOLEUM)	$ 45.91	26.76
CEMENT MASON	$ 56.09	15.43
DRYWALL TAPER	$ 34.94	26.49
ELECTRICIAN	$ 49.49	27.25
ELEVATOR CONSTRUCTOR	$ 65.21	46.21
FLAG PERSON	$ 26.42	0.08
GLAZIER	$ 39.24	13.46
HEATING AND FROST INSULATOR	$ 59.39	33.85
IRONWORKER	$ 49.50	37.86
LABORER: COMMON (GENERAL LABOR WORK)	$ 39.00	27.30
LABORER: LANDSCAPING (GARDENER, SOD LAYER AND NURSERY OPERATOR)	$ 24.02	0.00
LABORER: SKILLED (ASSISTING SKILLED CRAFT JOURNEYMAN)	$ 39.00	27.30
LANDSCAPING EQUIPMENT (INCLUDES HYDRO SEEDER OR MULCHER, SOD ROLLER, FARM TRACTOR WITH ATTACHMENT SPECIFICALLY SEEDING, SODDING, OR PLANT, AND TWO-FRAMED FORKLIFT (EXCLUDING FRONT, POSIT-TRACK, AND SKID STEER LOADERS), NO EARTHWORK OR GRADING FOR ELEVATIONS)	$ 26.89	19.31
LATHER	$ 46.81	27.35
MILLWRIGHT	$ 46.15	37.81
OFF-ROAD TRUCK	$ 28.61	16.60
PAINTER (INCLUDING HAND BRUSHED, HAND SPRAYED, AND THE TAPING OF PAVEMENT MARKINGS)	$ 35.28	26.16
PAVEMENT MARKING OR MARKING REMOVAL EQUIPMENT ((ONE OR TWO PERSON OPERATORS); SELF-PROPELLED TRUCK OR TRAILER MOUNTED UNITS.)	$ 27.26	16.59
PILEDRIVER (INCLUDING VIBRATORY DRIVER OR EXTRACTOR		

FOR PILING AND SHEETING OPERATIONS)	$ 47.71	31.98
PIPEFITTER/STEAMFITTER	$ 54.91	33.58
PIPELAYER (WATER, SEWER AND GAS)	$ 44.67	26.90
PLASTERER	$ 45.33	19.96
PLUMBER	$ 44.11	19.50
POWER EQUIPMENT OPERATOR: COMMERCIAL GROUP 1 : HELICOPTER PILOT; TOWER CRANE 250 FEET AND OVER; TRUCK CRAWLER CRANE WITH 200 FEET OF BOOM AND OVER, INCLUDING JIB	$ 54.21	31.00
POWER EQUIPMENT OPERATOR: COMMERCIAL GROUP 2 : CONCRETE PUMP WITH 50 METERS/164 FEET OF BOOM AND OVER; PILE DRIVING WHEN THREE DRUMS IN USE; TOWER CRANE 200 FEET AND OVER; TRUCK OR CRAWLER CRANE WITH 150 FEET OF BOOM UP TO AND NOT INCLUDING 200 FEET, INCLUDING JIB	$ 53.79	31.00
POWER EQUIPMENT OPERATOR: COMMERCIAL GROUP 3 : ALL-TERRAIN VEHICLE CRANES; CONCRETE PUMP 32-49 METERS/102-164 FEET; DERRICK (GUY & STIFFLEG); STATIONARY TOWER CRANE UP TO 200 FEET; SELF-ERECTING TOWER CRANE 100 FEET AND OVER MEASURED FROM BOOM FOOT PIN; TRAVELING TOWER CRANE; TRUCK OR CRAWLER CRANE UP TO AND NOT INCLUDING 150 FEET OF BOOM, INCLUDING JIB	$ 52.08	31.00
POWER EQUIPMENT OPERATOR: COMMERCIAL GROUP 4 : CRAWLER BACKHOE INCLUDING ATTACHMENTS; FIREPERSON, CHIEF BOILER LICENSE; HOIST ENGINEER (THREE DRUMS OR MORE); LOCOMOTIVE; OVERHEAD CRANE (INSIDE BUILDING PERIMETER); TRACTOR . BOOM TYPE	$ 51.68	31.00
POWER EQUIPMENT OPERATOR: COMMERCIAL GROUP 5 : AIR COMPRESSOR 450 CFM OR OVER (TWO OR MORE MACHINES); CONCRETE MIXER; CONCRETE PUMP UP TO 31 METERS/101 FEET OF BOOM; DRILL RIGS, HEAVY ROTARY OR CHURN OR CABLE DRILL WHEN USED FOR CAISSON FOR ELEVATOR OR BUILDING CONSTRUCTION; FORKLIFT; FRONT END, SKID STEER 1 C YD AND OVER; HOIST ENGINEER (ONE OR TWO DRUMS); MECHANIC-WELDER (ON POWER EQUIPMENT); POWER PLANT (100 KW AND OVER OR MULTIPLES EQUAL TO 100KW AND OVER); PUMP OPERATOR AND/OR CONVEYOR (TWO OR MORE MACHINES); SELF-ERECTING TOWER CRANE UNDER 100 FEET MEASURED FROM BOOM FOOT PIN; STRADDLE CARRIER; TRACTOR OVER D2; WELL POINT PUMP	$ 48.52	31.00
POWER EQUIPMENT OPERATOR: COMMERCIAL GROUP 6 : CONCRETE BATCH PLANT; FIREPERSON, FIRST CLASS BOILER LICENSE; FRONT END, SKID STEER UP TO 1 C YD; GUNITE MACHINE; TRACTOR OPERATOR D2 OR SIMILAR SIZE; TRENCHING MACHINE (SEWER, WATER, GAS) EXCLUDES WALK BEHIND TRENCHER	$ 46.71	31.00
POWER EQUIPMENT OPERATOR: COMMERCIAL GROUP 7 : AIR COMPRESSOR 600 CFM OR OVER; BRAKEPERSON; CONCRETE PUMP/PUMPCRETE OR COMPLACO TYPE; FIREPERSON, TEMPORARY HEAT SECOND CLASS BOILER LICENSE; OILER (POWER SHOVEL, CRANE, TRUCK CRANE, DRAGLINE, CRUSHERS AND MILLING MACHINES, OR OTHER SIMILAR POWER EQUIPMENT); PICK UP SWEEPER (ONE CUBIC YARD HOPPER CAPACITY); PUMP AND/OR CONVEYOR	$ 45.34	31.00
POWER EQUIPMENT OPERATOR: COMMERCIAL GROUP 8 : ELEVATOR OPERATOR; GREASER; MECHANICAL SPACE HEATER (TEMPORARY HEAT NO BOILER LICENSE REQUIRED)	$ 42.90	31.00
POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 2 : GRADER OR MOTOR PATROL; TUGBOAT 100 H.P. AND OVER WHEN LICENSE REQUIRED	$ 37.00	0.00
POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 3 : ASPHALT BITUMINOUS STABILIZER PLANT; CABLEWAY; DERRICK (GUY OR STIFFLEG)(POWER)(SKIDS OR STATIONARY); DREDGE OR ENGINEERS, DREDGE (POWER)		

AND ENGINEER; LOCOMOTIVE CRANE OPERATOR; TANDEM SCRAPER; TUGBOAT 100 H.P AND OVER.....$ 40.09 25.00
POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 4 : AIR TRACK ROCK DRILL; AUTOMATIC ROAD MACHINE (CMI OR SIMILAR); BACKFILLER OPERATOR; BITUMINOUS ROLLERS, RUBBER TIRED OR STEEL DRUMMED (EIGHT TONS AND OVER); BITUMINOUS SPREADER AND FINISHING MACHINES (POWER), INCLUDING PAVERS, MACRO SURFACING AND MICRO SURFACING, OR SIMILAR TYPES (OPERATOR AND SCREED PERSON); BROKK OR R.T.C. REMOTE CONTROL OR SIMILAR TYPE WITH ALL ATTACHMENTS; CAT CHALLENGER TRACTORS OR SIMILAR TYPES PULLING ROCK WAGONS, BULLDOZERS AND SCRAPERS; CHIP HARVESTER AND TREE CUTTER; CONCRETE DISTRIBUTOR AND SPREADER FINISHING MACHINE, LONGITUDINAL FLOAT, JOINT MACHINE, AND SPRAY MACHINE; CONCRETE MOBIL; CRUSHING PLANT (GRAVEL AND STONE) OR GRAVEL WASHING, CRUSHING AND SCREENING PLANT; CURB MACHINE; DIRECTIONAL BORING MACHINE; DOPE MACHINE (PIPELINE); DUAL TRACTOR; ELEVATING GRADER; GPS REMOTE OPERATING OF EQUIPMENT; HYDRAULIC TREE PLANTER; LAUNCHER PERSON (TANKER PERSON OR PILOT LICENSE); LOCOMOTIVE; MILLING, GRINDING, PLANNING, FINE GRADE, OR TRIMMER MACHINE; PAVEMENT BREAKER OR TAMPING MACHINE (POWER DRIVEN) MIGHTY MITE OR SIMILAR TYPE; PIPELINE WRAPPING, CLEANING OR BENDING MACHINE; POWER ACTUATED HORIZONTAL BORING MACHINE, OVER SIX INCHES; PUGMILL; RUBBER-TIRED FARM TRACTOR WITH BACKHOE INCLUDING ATTACHMENTS; SCRAPER; SELF-PROPELLED SOIL STABILIZER; SLIP FORM (POWER DRIVEN) (PAVING); TIE TAMPER AND BALLAST MACHINE; TRACTOR, WHEEL TYPE, OVER 50 H.P. WITH PTO UNRELATED TO LANDSCAPING; TUB GRINDER, MORBARK, OR SIMILAR TYPE.....$ 44.54 30.94
POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 5 : BITUMINOUS ROLLER (UNDER EIGHT TONS); CONCRETE SAW (MULTIPLE BLADE) (POWER OPERATED); FORM TRENCH DIGGER (POWER); HYDRAULIC LOG SPLITTER; LOADER (BARBER GREENE OR SIMILAR TYPE); POST HOLE DRIVING MACHINE/POST HOLE AUGER; POWER ACTUATED JACK; SELF-PROPELLED CHIP SPREADER (FLAHERTY OR SIMILAR); SHEEP FOOT COMPACTOR WITH BLADE . 200 H.P. AND OVER; SHOULDERING MACHINE (POWER) APSCO OR SIMILAR TYPE INCLUDING SELF-PROPELLED SAND AND CHIP SPREADER; STUMP CHIPPER AND TREE CHIPPER; TREE FARMER (MACHINE).....$ 28.93 3.06
POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 6 : CAT, CHALLENGER, OR SIMILAR TYPE OF TRACTORS, WHEN PULLING DISK OR ROLLER; DREDGE DECK HAND; GRAVEL SCREENING PLANT (PORTABLE NOT CRUSHING OR WASHING); LEVER PERSON; POWER SWEEPER; SHEEP FOOT ROLLER AND ROLLERS ON GRAVEL COMPACTION, INCLUDING VIBRATING ROLLERS; TRACTOR, WHEEL TYPE, OVER 50 H.P., UNRELATED TO LANDSCAPING.....$ 27.74 19.70
ROOFER.....$ 34.46 20.15
SHEET METAL WORKER.....$ 43.53 28.98
SIGN ERECTOR.....$ 34.91 20.31
SPRINKLER FITTER.....$ 48.71 28.56
SURVEY FIELD TECHNICIAN (OPERATE TOTAL STATION, GPS RECEIVER, LEVEL, ROD OR RANGE POLES, STEEL TAPE MEASUREMENT; MARK AND DRIVE STAKES; HAND OR POWER DIGGING FOR AND IDENTIFICATION OF MARKERS OR MONUMENTS; PERFORM AND CHECK CALCULATIONS; REVIEW AND UNDERSTAND CONSTRUCTION PLANS AND LAND SURVEY MATERIALS). .....$ 28.00 10.00

TERRAZZO WORKER	$ 40.53	19.83
TILE FINISHER	$ 30.76	6.02
TILE SETTER	$ 45.25	0.91
TRAFFIC CONTROL PERSON (TEMPORARY SIGNAGE)	$ 23.17	17.67
TRUCK DRIVER GROUP 1 : MECHANIC . WELDER; TRACTOR TRAILER DRIVER; TRUCK DRIVER (HAULING MACHINERY INCLUDING OPERATION OF HAND AND POWER OPERATED WINCHES)	$ 35.00	0.00
TRUCK DRIVER GROUP 2 : FOUR OR MORE AXLE UNIT, STRAIGHT BODY TRUCK	$ 24.75	1.54
TRUCK DRIVER GROUP 3 : BITUMINOUS DISTRIBUTOR DRIVER; BITUMINOUS DISTRIBUTOR (ONE PERSON OPERATION); THREE AXLE UNITS	$ 16.85	6.80
TRUCK DRIVER GROUP 4 : BITUMINOUS DISTRIBUTOR SPRAY OPERATOR (REAR AND OILER); DUMP PERSON; GREASER; PILOT CAR DRIVER; RUBBER-TIRED, SELF-PROPELLED PACKER UNDER 8 TONS; TWO AXLE UNIT; SLURRY OPERATOR; TRACTOR OPERATOR, UNDER 50 H.P.	$ 25.71	8.71
UNDERGROUND AND OPEN DITCH LABORER (EIGHT FEET BELOW STARTING GRADE LEVEL)	$ 32.01	21.84
WIRING SYSTEM TECHNICIAN	$ 54.44	24.02
WIRING SYSTEMS INSTALLER	$ 38.15	19.15

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Note: Executive Order 13658 generally applies to contracts subject to the Davis-Bacon Act that were awarded on or between January 1, 2015 and January 29, 2022, and that have not been renewed or extended on or after January 30, 2022. Executive Order 13658 does not apply to contracts subject only to the Davis-Bacon Related Acts regardless of when they were awarded. If a contract is subject to Executive Order 13658, the contractor must pay all covered workers at least $13.65 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract from May 11, 2026, through December 31, 2026. The applicable Executive Order minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under Executive Order 13658 is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses

(29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than SU, UAVG, SA, or SC denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The SU identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date,

6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

SU wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The SA identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the SA identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination
c) an initial WHD letter setting forth a position on a wage determination matter
d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

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Wage and Hour Division
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2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION"

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"General Decision Number: MN20260236 07/30/2026

State: Minnesota

Construction Types: Heavy and Highway

Counties: Minnesota Counties of
Dodge, Fillmore, Freeborn, Goodhue,
Houston, Mower, Olmsted, Rice, Steele,
Wabasha and Winona

Please refer to Minnesota Rules 5200.1100, 5200.1101, and 5200.1102 for definitions of labor classifications on this wage determination, and direct any questions regarding such classifications to the Branch of Construction Wage Determinations.

Modification Number	Publication Date
0	01/02/2026
1	05/18/2026
2	07/30/2026

SAMN2025-001 11/03/2025

	Rates	Fringes
ARTICULATED HAULER	$ 47.68	31.00
ASBESTOS ABATEMENT WORKER	$ 36.23	22.26
BLASTER	$ 42.01	26.01
BOILERMAKER	$ 48.35	31.93
BOOM TRUCK	$ 48.96	29.40
BRICKLAYER	$ 36.05	19.68
CARPENTER	$ 50.76	32.17
CARPET LAYER (LINOLEUM)	$ 35.32	14.03
CEMENT MASON	$ 56.13	14.34
ELECTRICIAN	$ 49.49	27.25
FLAG PERSON	$ 39.01	26.01
GROUND PERSON	$ 33.40	16.30
HEATING AND FROST INSULATOR	$ 43.90	23.05
IRONWORKER	$ 49.50	37.86
LABORER: COMMON (GENERAL LABOR WORK)	$ 39.01	26.01
LABORER: LANDSCAPING (GARDENER, SOD LAYER AND NURSERY OPERATOR)	$ 31.66	22.78
LABORER: SKILLED (ASSISTING SKILLED CRAFT JOURNEYMAN)	$ 39.01	26.01
LANDSCAPING EQUIPMENT (INCLUDES HYDRO SEEDER OR MULCHER, SOD ROLLER, FARM TRACTOR WITH ATTACHMENT SPECIFICALLY SEEDING, SODDING, OR PLANT, AND TWO-FRAMED FORKLIFT (EXCLUDING FRONT, POSIT-TRACK, AND SKID STEER LOADERS), NO EARTHWORK OR GRADING FOR ELEVATIONS)	$ 42.60	31.00
LINEMAN	$ 46.32	20.12
MILLWRIGHT	$ 41.70	31.81
OFF-ROAD TRUCK	$ 44.67	26.40
PAINTER (INCLUDING HAND BRUSHED, HAND SPRAYED, AND THE TAPING OF PAVEMENT MARKINGS)	$ 50.50	29.09
PAVEMENT MARKING OR MARKING REMOVAL EQUIPMENT ((ONE OR TWO PERSON OPERATORS); SELF-PROPELLED TRUCK OR TRAILER MOUNTED UNITS.)	$ 33.91	23.49

PILEDRIVER (INCLUDING VIBRATORY DRIVER OR EXTRACTOR FOR PILING AND SHEETING OPERATIONS).....$ 50.90 31.98
PIPEFITTER/STEAMFITTER.....$ 64.09 36.45
PIPELAYER (WATER, SEWER AND GAS).....$ 42.51 26.01
PLUMBER.....$ 49.91 33.58
POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 2 : HELICOPTER PILOT; CONCRETE PUMP; ALL CRANES WITH OVER 135-FOOT BOOM, EXCLUDING JIB; DRAGLINE, CRAWLER, HYDRAULIC BACKHOE (TRACK OR WHEEL MOUNTED) AND/OR OTHER SIMILAR EQUIPMENT WITH SHOVEL-TYPE CONTROLS THREE CUBIC YARDS AND OVER MANUFACTURER.S RATED CAPACITY INCLUDING ALL ATTACHMENTS.; GRADER OR MOTOR PATROL; PILE DRIVING; TUGBOAT 100 H.P. AND OVER WHEN LICENSE REQUIRED.....$ 48.71 31.00
POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 3 : ASPHALT BITUMINOUS STABILIZER PLANT; CABLEWAY; CONCRETE MIXER, STATIONARY PLANT; DERRICK (GUY OR STIFFLEG)(POWER)(SKIDS OR STATIONARY); DRAGLINE, CRAWLER, HYDRAULIC BACKHOE (TRACK OR WHEEL MOUNTED) AND/OR SIMILAR EQUIPMENT WITH SHOVEL-TYPE CONTROLS, UP TO THREE CUBIC YARDS MANUFACTURER.S RATED CAPACITY INCLUDING ALL ATTACHMENTS; DREDGE OR ENGINEERS, DREDGE (POWER) AND ENGINEER; FRONT END LOADER, FIVE CUBIC YARDS AND OVER INCLUDING ATTACHMENTS.; LOCOMOTIVE CRANE OPERATOR; MIXER (PAVING) CONCRETE PAVING, ROAD MOLE, INCLUDING MUCKING OPERATIONS, CONWAY OR SIMILAR TYPE; MECHANIC . WELDER ON POWER EQUIPMENT; TRACTOR . BOOM TYPE; TANDEM SCRAPER; TRUCK CRANE . CRAWLER CRANE; TUGBOAT 100 H.P AND OVER.....$ 48.05 31.00
POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 4 : AIR TRACK ROCK DRILL; AUTOMATIC ROAD MACHINE (CMI OR SIMILAR); BACKFILLER OPERATOR; CONCRETE BATCH PLANT OPERATOR; BITUMINOUS ROLLERS, RUBBER TIRED OR STEEL DRUMMED (EIGHT TONS AND OVER); BITUMINOUS SPREADER AND FINISHING MACHINES (POWER), INCLUDING PAVERS, MACRO SURFACING AND MICRO SURFACING, OR SIMILAR TYPES (OPERATOR AND SCREED PERSON); BROKK OR R.T.C. REMOTE CONTROL OR SIMILAR TYPE WITH ALL ATTACHMENTS; CAT CHALLENGER TRACTORS OR SIMILAR TYPES PULLING ROCK WAGONS, BULLDOZERS AND SCRAPERS; CHIP HARVESTER AND TREE CUTTER; CONCRETE DISTRIBUTOR AND SPREADER FINISHING MACHINE, LONGITUDINAL FLOAT, JOINT MACHINE, AND SPRAY MACHINE; CONCRETE MIXER ON JOBSITE; CONCRETE MOBIL; CRUSHING PLANT (GRAVEL AND STONE) OR GRAVEL WASHING, CRUSHING AND SCREENING PLANT; CURB MACHINE; DIRECTIONAL BORING MACHINE; DOPE MACHINE (PIPELINE); DRILL RIGS, HEAVY ROTARY OR CHURN OR CABLE DRIL; DUAL TRACTOR; ELEVATING GRADER; FORK LIFT OR STRADDLE CARRIER; FORK LIFT OR LUMBER STACKER; FRONT END, SKID STEER OVER 1 TO 5 C YD; GPS REMOTE OPERATING OF EQUIPMENT; HOIST ENGINEER (POWER); HYDRAULIC TREE PLANTER; LAUNCHER PERSON (TANKER PERSON OR PILOT LICENSE); LOCOMOTIVE; MILLING, GRINDING, PLANNING, FINE GRADE, OR TRIMMER MACHINE; MULTIPLE MACHINES, SUCH AS AIR COMPRESSORS, WELDING MACHINES, GENERATORS, PUMPS; PAVEMENT BREAKER OR TAMPING MACHINE (POWER DRIVEN) MIGHTY MITE OR SIMILAR TYPE; PICKUP SWEEPER, ONE CUBIC YARD AND OVER HOPPER CAPACITY; PIPELINE WRAPPING, CLEANING OR BENDING MACHINE; POWER PLANT ENGINEER, 100 KWH AND OVER; POWER ACTUATED HORIZONTAL BORING MACHINE, OVER SIX INCHES; PUGMILL; PUMPCRETE; RUBBER-TIRED FARM TRACTOR WITH

BACKHOE INCLUDING ATTACHMENTS; SCRAPER; SELF-PROPELLED SOIL STABILIZER; SLIP FORM (POWER DRIVEN) (PAVING); TIE TAMPER AND BALLAST MACHINE; TRACTOR, BULLDOZER; TRACTOR, WHEEL TYPE, OVER 50 H.P. WITH PTO UNRELATED TO LANDSCAPING; TRENCHING MACHINE (SEWER, WATER, GAS) EXCLUDES WALK BEHIND TRENCHER; TUB GRINDER, MORBARK, OR SIMILAR TYPE; WELL POINT DISMANTLING OR INSTALLATION.....$ 47.68 31.00

POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 5 : AIR COMPRESSOR, 600 CFM OR OVER; BITUMINOUS ROLLER (UNDER EIGHT TONS); CONCRETE SAW (MULTIPLE BLADE) (POWER OPERATED); FORM TRENCH DIGGER (POWER); FRONT END, SKID STEER UP TO 1C YD; GUNITE GUNALL; HYDRAULIC LOG SPLITTER; LOADER (BARBER GREENE OR SIMILAR TYPE); POST HOLE DRIVING MACHINE/POST HOLE AUGER; POWER ACTUATED AUGER AND BORING MACHINE; POWER ACTUATED JACK; PUMP; SELF-PROPELLED CHIP SPREADER (FLAHERTY OR SIMILAR); SHEEP FOOT COMPACTOR WITH BLADE . 200 H.P. AND OVER; SHOULDERING MACHINE (POWER) APSCO OR SIMILAR TYPE INCLUDING SELF-PROPELLED SAND AND CHIP SPREADER; STUMP CHIPPER AND TREE CHIPPER; TREE FARMER (MACHINE).....$ 44.06 31.00

POWER EQUIPMENT OPERATOR: HIGHWAY/HEAVY GROUP 6 : CAT, CHALLENGER, OR SIMILAR TYPE OF TRACTORS, WHEN PULLING DISK OR ROLLER; CONVEYOR; DREDGE DECK HAND; FIRE PERSON OR TANK CAR HEATER; GRAVEL SCREENING PLANT (PORTABLE NOT CRUSHING OR WASHING); GREASER (TRACTOR); LEVER PERSON; OILER (POWER SHOVEL, CRANE, TRUCK CRANE, DRAGLINE, CRUSHERS, AND MILLING MACHINES, OR OTHER SIMILAR HEAVY EQUIPMENT); POWER SWEEPER; SHEEP FOOT ROLLER AND ROLLERS ON GRAVEL COMPACTION, INCLUDING VIBRATING ROLLERS; TRACTOR, WHEEL TYPE, OVER 50 H.P., UNRELATED TO LANDSCAPING..$ 42.60 31.00

SHEET METAL WORKER.....$ 57.96 34.57

SURVEY FIELD TECHNICIAN (OPERATE TOTAL STATION, GPS RECEIVER, LEVEL, ROD OR RANGE POLES, STEEL TAPE MEASUREMENT; MARK AND DRIVE STAKES; HAND OR POWER DIGGING FOR AND IDENTIFICATION OF MARKERS OR MONUMENTS; PERFORM AND CHECK CALCULATIONS; REVIEW AND UNDERSTAND CONSTRUCTION PLANS AND LAND SURVEY MATERIALS). .....$ 28.18 20.07

TRAFFIC CONTROL PERSON (TEMPORARY SIGNAGE).....$ 26.42 0.08

TRUCK DRIVER GROUP 1 : MECHANIC . WELDER; TRACTOR TRAILER DRIVER; TRUCK DRIVER (HAULING MACHINERY INCLUDING OPERATION OF HAND AND POWER OPERATED WINCHES).....$ 40.64 25.40

TRUCK DRIVER GROUP 2 : FOUR OR MORE AXLE UNIT, STRAIGHT BODY TRUCK.....$ 39.97 25.40

TRUCK DRIVER GROUP 3 : BITUMINOUS DISTRIBUTOR DRIVER; BITUMINOUS DISTRIBUTOR (ONE PERSON OPERATION); THREE AXLE UNITS.....$ 35.50 21.75

TRUCK DRIVER GROUP 4 : BITUMINOUS DISTRIBUTOR SPRAY OPERATOR (REAR AND OILER); DUMP PERSON; GREASER; PILOT CAR DRIVER; RUBBER-TIRED, SELF-PROPELLED PACKER UNDER 8 TONS; TWO AXLE UNIT; SLURRY OPERATOR; TRACTOR OPERATOR, UNDER 50 H.P.....$ 35.74 21.76

TUNNEL MINER.....$ 33.51 22.39

UNDERGROUND AND OPEN DITCH LABORER (EIGHT FEET BELOW STARTING GRADE LEVEL).....$ 40.51 26.01

WIRING SYSTEM TECHNICIAN.....$ 51.07 23.52

WIRING SYSTEMS INSTALLER.....$ 26.49 12.40

WELDERS - Receive rate prescribed for craft performing

operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Note: Executive Order 13658 generally applies to contracts subject to the Davis-Bacon Act that were awarded on or between January 1, 2015 and January 29, 2022, and that have not been renewed or extended on or after January 30, 2022. Executive Order 13658 does not apply to contracts subject only to the Davis-Bacon Related Acts regardless of when they were awarded. If a contract is subject to Executive Order 13658, the contractor must pay all covered workers at least $13.65 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract from May 11, 2026, through December 31, 2026. The applicable Executive Order minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under Executive Order 13658 is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than SU, UAVG, SA, or SC denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in

processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The SU identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

SU wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The SA identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the SA identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination
c) an initial WHD letter setting forth a position on a wage determination matter
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2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION"

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6.7 Required Conditions: MN DOLI and Industry Prevailing Wages for State Funded Construction Projects

Insert applicable Minnesota Prevailing Wages here

MINNESOTA DEPARTMENT OF LABOR AND INDUSTRY PREVAILING WAGES FOR STATE FUNDED CONSTRUCTION PROJECTS

THIS NOTICE MUST BE POSTED ON THE JOBSITE IN A CONSPICUOUS PLACE

Construction Type: Commercial

County Number: 23

County Name: FILLMORE

Effective: 2025-12-22

This project is covered by Minnesota prevailing wage statutes. Wage rates listed below are the minimum hourly rates to be paid on this project.

All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at a rate of one and one half (1 1/2) times the basic hourly rate. *Note: Overtime pay after eight (8) hours on the project must be paid even if the worker does not exceed forty (40) hours in the work week.*

Violations should be reported to:

Department of Labor and Industry
Prevailing Wage Section
443 Lafayette Road N
St Paul, MN 55155
(651) 284-5091
DLI.PrevWage@state.mn.us

* Indicates that adjacent county rates were used for the labor class listed.

County: FILLMORE (23)

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
LABORERS (101 - 112) (SPECIAL CRAFTS 701 - 730)					
101	LABORER, COMMON (GENERAL LABOR WORK)	2025-12-22	36.50	25.55	62.05
		2026-05-01	39.00	27.30	66.30
102	LABORER, SKILLED (ASSISTING SKILLED CRAFT JOURNEYMAN)	2025-12-22	36.50	25.55	62.05
		2026-05-01	39.00	27.30	66.30
103*	LABORER, LANDSCAPING (GARDENER, SOD LAYER AND NURSERY OPERATOR)	2025-12-22	24.02	0.00	24.02
104*	FLAG PERSON	2025-12-22	26.42	0.08	26.50
105*	WATCH PERSON	2025-12-22	30.87	22.82	53.69
106	BLASTER				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
		FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
107*	PIPELAYER (WATER, SEWER AND GAS)	2025-12-22	44.67	26.90	71.57
108	TUNNEL MINER	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
109*	UNDERGROUND AND OPEN DITCH LABORER (EIGHT FEET BELOW STARTING GRADE LEVEL)	2025-12-22	32.01	21.84	53.85
110*	SURVEY FIELD TECHNICIAN (OPERATE TOTAL STATION, GPS RECEIVER, LEVEL, ROD OR RANGE POLES, STEEL TAPE MEASUREMENT; MARK AND DRIVE STAKES; HAND OR POWER DIGGING FOR AND IDENTIFICATION OF MARKERS OR MONUMENTS; PERFORM AND CHECK CALCULATIONS; REVIEW AND UNDERSTAND CONSTRUCTION PLANS AND LAND SURVEY MATERIALS). THIS CLASSIFICATION DOES NOT APPLY TO THE WORK PERFORMED ON A PREVAILING WAGE PROJECT BY A LAND SURVEYOR WHO IS LICENSED PURSUANT TO MINNESOTA STATUTES, SECTIONS 326.02 TO 326.15.	2025-12-22	28.00	10.00	38.00
111	TRAFFIC CONTROL PERSON (TEMPORARY SIGNAGE)	2025-12-22	23.17	17.67	40.84
SPECIAL EQUIPMENT (201 - 204)					
201*	ARTICULATED HAULER	2025-12-22	33.00	7.50	40.50
202*	BOOM TRUCK	2025-12-22	47.25	29.40	76.65
		2026-05-04	48.52	31.00	79.52
203*	LANDSCAPING EQUIPMENT, INCLUDES HYDRO SEEDER OR MULCHER, SOD ROLLER, FARM TRACTOR WITH ATTACHMENT SPECIFICALLY SEEDING, SODDING, OR PLANT, AND TWO-FRAMED FORKLIFT (EXCLUDING FRONT, POSIT-TRACK, AND SKID STEER LOADERS), NO EARTHWORK OR	2025-12-22	26.89	19.31	46.20

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
	GRADING FOR ELEVATIONS				
204*	OFF-ROAD TRUCK	2025-12-22	28.61	16.60	45.21
205	PAVEMENT MARKING OR MARKING REMOVAL EQUIPMENT (ONE OR TWO PERSON OPERATORS); SELF-PROPELLED TRUCK OR TRAILER MOUNTED UNITS.	2025-12-22	27.26	16.59	43.85
HIGHWAY/HEAVY POWER EQUIPMENT OPERATOR					
GROUP 2 *		2025-12-22	37.00	0.00	37.00
306	GRADER OR MOTOR PATROL				
308	TUGBOAT 100 H.P. AND OVER WHEN LICENSE REQUIRED (HIGHWAY AND HEAVY ONLY)				
GROUP 3 *		2025-12-22	40.09	25.00	65.09
309	ASPHALT BITUMINOUS STABILIZER PLANT				
310	CABLEWAY				
312	DERRICK (GUY OR STIFFLEG)(POWER)(SKIDS OR STATIONARY) (HIGHWAY AND HEAVY ONLY)				
314	DREDGE OR ENGINEERS, DREDGE (POWER) AND ENGINEER				
316	LOCOMOTIVE CRANE OPERATOR				
320	TANDEM SCRAPER				
322	TUGBOAT 100 H.P AND OVER (HIGHWAY AND HEAVY ONLY)				
GROUP 4		2025-12-22	43.24	29.34	72.58
		2026-05-04	44.54	30.94	75.48
323	AIR TRACK ROCK DRILL				
324	AUTOMATIC ROAD MACHINE (CMI OR SIMILAR) (HIGHWAY AND HEAVY ONLY)				
325	BACKFILLER OPERATOR				
327	BITUMINOUS ROLLERS, RUBBER TIRED OR STEEL DRUMMED (EIGHT TONS AND OVER)				
328	BITUMINOUS SPREADER AND FINISHING MACHINES (POWER), INCLUDING PAVERS, MACRO SURFACING AND MICRO SURFACING, OR SIMILAR TYPES (OPERATOR AND SCREED PERSON)				
329	BROKK OR R.T.C. REMOTE CONTROL OR SIMILAR TYPE WITH ALL ATTACHMENTS				
330	CAT CHALLENGER TRACTORS OR SIMILAR TYPES PULLING ROCK WAGONS, BULLDOZERS AND SCRAPERS				
331	CHIP HARVESTER AND TREE CUTTER				
332	CONCRETE DISTRIBUTOR AND SPREADER FINISHING MACHINE, LONGITUDINAL FLOAT, JOINT MACHINE, AND SPRAY MACHINE				
334	CONCRETE MOBIL (HIGHWAY AND HEAVY ONLY)				
335	CRUSHING PLANT (GRAVEL AND STONE) OR GRAVEL WASHING, CRUSHING AND SCREENING PLANT				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
336	CURB MACHINE				
337	DIRECTIONAL BORING MACHINE				
338	DOPE MACHINE (PIPELINE)				
340	DUAL TRACTOR				
341	ELEVATING GRADER				
345	GPS REMOTE OPERATING OF EQUIPMENT				
347	HYDRAULIC TREE PLANTER				
348	LAUNCHER PERSON (TANKER PERSON OR PILOT LICENSE)				
349	LOCOMOTIVE (HIGHWAY AND HEAVY ONLY)				
350	MILLING, GRINDING, PLANNING, FINE GRADE, OR TRIMMER MACHINE				
352	PAVEMENT BREAKER OR TAMPING MACHINE (POWER DRIVEN) MIGHTY MITE OR SIMILAR TYPE				
354	PIPELINE WRAPPING, CLEANING OR BENDING MACHINE				
356	POWER ACTUATED HORIZONTAL BORING MACHINE, OVER SIX INCHES				
357	PUGMILL				
359	RUBBER-TIRED FARM TRACTOR WITH BACKHOE INCLUDING ATTACHMENTS (HIGHWAY AND HEAVY ONLY)				
360	SCRAPER				
361	SELF-PROPELLED SOIL STABILIZER				
362	SLIP FORM (POWER DRIVEN) (PAVING)				
363	TIE TAMPER AND BALLAST MACHINE				
365	TRACTOR, WHEEL TYPE, OVER 50 H.P. WITH PTO UNRELATED TO LANDSCAPING (HIGHWAY AND HEAVY ONLY)				
367	TUB GRINDER, MORBARK, OR SIMILAR TYPE				
GROUP 5 *		2025-12-22	28.93	3.06	31.99
370	BITUMINOUS ROLLER (UNDER EIGHT TONS)				
371	CONCRETE SAW (MULTIPLE BLADE) (POWER OPERATED)				
372	FORM TRENCH DIGGER (POWER)				
375	HYDRAULIC LOG SPLITTER				
376	LOADER (BARBER GREENE OR SIMILAR TYPE)				
377	POST HOLE DRIVING MACHINE/POST HOLE AUGER				
379	POWER ACTUATED JACK				
381	SELF-PROPELLED CHIP SPREADER (FLAHERTY OR SIMILAR)				
382	SHEEP FOOT COMPACTOR WITH BLADE . 200 H.P. AND OVER				
383	SHOULDERING MACHINE (POWER) APSCO OR SIMILAR TYPE INCLUDING SELF-PROPELLED SAND AND CHIP SPREADER				
384	STUMP CHIPPER AND TREE CHIPPER				
385	TREE FARMER (MACHINE)				
GROUP 6 *		2025-12-22	27.74	19.70	47.44
387	CAT, CHALLENGER, OR SIMILAR TYPE OF TRACTORS, WHEN PULLING DISK OR ROLLER				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
389	DREDGE DECK HAND				
391	GRAVEL SCREENING PLANT (PORTABLE NOT CRUSHING OR WASHING)				
393	LEVER PERSON				
395	POWER SWEEPER				
396	SHEEP FOOT ROLLER AND ROLLERS ON GRAVEL COMPACTION, INCLUDING VIBRATING ROLLERS				
397	TRACTOR, WHEEL TYPE, OVER 50 H.P., UNRELATED TO LANDSCAPING				
COMMERCIAL POWER EQUIPMENT OPERATOR					
GROUP 1 *		2025-12-22	52.39	29.40	81.79
		2026-05-04	54.21	31.00	85.21
501	HELICOPTER PILOT (COMMERCIAL CONSTRUCTION ONLY)				
502	TOWER CRANE 250 FEET AND OVER (COMMERCIAL CONSTRUCTION ONLY)				
503	TRUCK CRAWLER CRANE WITH 200 FEET OF BOOM AND OVER, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 2 *		2025-12-22	51.99	29.40	81.39
		2026-05-04	53.79	31.00	84.79
504	CONCRETE PUMP WITH 50 METERS/164 FEET OF BOOM AND OVER (COMMERCIAL CONSTRUCTION ONLY)				
505	PILE DRIVING WHEN THREE DRUMS IN USE (COMMERCIAL CONSTRUCTION ONLY)				
506	TOWER CRANE 200 FEET AND OVER (COMMERCIAL CONSTRUCTION ONLY)				
507	TRUCK OR CRAWLER CRANE WITH 150 FEET OF BOOM UP TO AND NOT INCLUDING 200 FEET, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 3 *		2025-12-22	50.34	29.40	79.74
		2026-05-04	52.08	31.00	83.08
508	ALL-TERRAIN VEHICLE CRANES (COMMERCIAL CONSTRUCTION ONLY)				
509	CONCRETE PUMP 32-49 METERS/102-164 FEET (COMMERCIAL CONSTRUCTION ONLY)				
510	DERRICK (GUY & STIFFLEG) (COMMERCIAL CONSTRUCTION ONLY)				
511	STATIONARY TOWER CRANE UP TO 200 FEET				
512	SELF-ERECTING TOWER CRANE 100 FEET AND OVER MEASURED FROM BOOM FOOT PIN (COMMERCIAL CONSTRUCTION ONLY)				
513	TRAVELING TOWER CRANE (COMMERCIAL CONSTRUCTION ONLY)				
514	TRUCK OR CRAWLER CRANE UP TO AND NOT INCLUDING 150 FEET OF BOOM, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 4		2025-12-22	49.95	29.40	79.35
		2026-05-04	51.68	31.00	82.68
515	CRAWLER BACKHOE INCLUDING ATTACHMENTS (COMMERCIAL CONSTRUCTION ONLY)				
516	FIREPERSON, CHIEF BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
517	HOIST ENGINEER (THREE DRUMS OR MORE) (COMMERCIAL CONSTRUCTION ONLY)				
518	LOCOMOTIVE (COMMERCIAL CONSTRUCTION ONLY)				
519	OVERHEAD CRANE (INSIDE BUILDING PERIMETER) (COMMERCIAL CONSTRUCTION ONLY)				
520	TRACTOR . BOOM TYPE (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 5		2025-12-22	47.25	29.40	76.65
		2026-05-04	48.52	31.00	79.52
521	AIR COMPRESSOR 450 CFM OR OVER (TWO OR MORE MACHINES) (COMMERCIAL CONSTRUCTION ONLY)				
522	CONCRETE MIXER (COMMERCIAL CONSTRUCTION ONLY)				
523	CONCRETE PUMP UP TO 31 METERS/101 FEET OF BOOM				
524	DRILL RIGS, HEAVY ROTARY OR CHURN OR CABLE DRILL WHEN USED FOR CAISSON FOR ELEVATOR OR BUILDING CONSTRUCTION (COMMERCIAL CONSTRUCTION ONLY)				
525	FORKLIFT (COMMERCIAL CONSTRUCTION ONLY)				
526	FRONT END, SKID STEER 1 C YD AND OVER				
527	HOIST ENGINEER (ONE OR TWO DRUMS) (COMMERCIAL CONSTRUCTION ONLY)				
528	MECHANIC-WELDER (ON POWER EQUIPMENT) (COMMERCIAL CONSTRUCTION ONLY)				
529	POWER PLANT (100 KW AND OVER OR MULTIPLES EQUAL TO 100KW AND OVER) (COMMERCIAL CONSTRUCTION ONLY)				
530	PUMP OPERATOR AND/OR CONVEYOR (TWO OR MORE MACHINES) (COMMERCIAL CONSTRUCTION ONLY)				
531	SELF-ERECTING TOWER CRANE UNDER 100 FEET MEASURED FROM BOOM FOOT PIN (COMMERCIAL CONSTRUCTION ONLY)				
532	STRADDLE CARRIER (COMMERCIAL CONSTRUCTION ONLY)				
533	TRACTOR OVER D2 (COMMERCIAL CONSTRUCTION ONLY)				
534	WELL POINT PUMP (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 6		2025-12-22	45.50	29.40	74.90
		2026-05-04	46.71	31.00	77.71
535	CONCRETE BATCH PLANT (COMMERCIAL CONSTRUCTION ONLY)				
536	FIREPERSON, FIRST CLASS BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)				
537	FRONT END, SKID STEER UP TO 1 C YD				
538	GUNITE MACHINE (COMMERCIAL CONSTRUCTION ONLY)				
539	TRACTOR OPERATOR D2 OR SIMILAR SIZE (COMMERCIAL CONSTRUCTION ONLY)				
540	TRENCHING MACHINE (SEWER, WATER, GAS) EXCLUDES WALK BEHIND TRENCHER				
GROUP 7 *		2025-12-22	44.18	29.40	73.58
		2026-05-04	45.34	31.00	76.34
541	AIR COMPRESSOR 600 CFM OR OVER (COMMERCIAL CONSTRUCTION ONLY)				
542	BRAKEPERSON (COMMERCIAL CONSTRUCTION ONLY)				
543	CONCRETE PUMP/PUMPCRETE OR COMPLACO TYPE (COMMERCIAL CONSTRUCTION ONLY)				
544	FIREPERSON, TEMPORARY HEAT SECOND CLASS BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
545	OILER (POWER SHOVEL, CRANE, TRUCK CRANE, DRAGLINE, CRUSHERS AND MILLING MACHINES, OR OTHER SIMILAR POWER EQUIPMENT) (COMMERCIAL CONSTRUCTION ONLY)				
546	PICK UP SWEEPER (ONE CUBIC YARD HOPPER CAPACITY) (COMMERCIAL CONSTRUCTION ONLY)				
547	PUMP AND/OR CONVEYOR (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 8 *		2025-12-22	41.83	29.40	71.23
		2026-05-04	42.90	31.00	73.90
548	ELEVATOR OPERATOR (COMMERCIAL CONSTRUCTION ONLY)				
549	GREASER (COMMERCIAL CONSTRUCTION ONLY)				
550	MECHANICAL SPACE HEATER (TEMPORARY HEAT NO BOILER LICENSE REQUIRED) (COMMERCIAL CONSTRUCTION ONLY)				
TRUCK DRIVERS					
GROUP 1 *		2025-12-22	35.00	0.00	35.00
601	MECHANIC . WELDER				
602	TRACTOR TRAILER DRIVER				
603	TRUCK DRIVER (HAULING MACHINERY INCLUDING OPERATION OF HAND AND POWER OPERATED WINCHES)				
GROUP 2 *		2025-12-22	24.75	1.54	26.29
604	FOUR OR MORE AXLE UNIT, STRAIGHT BODY TRUCK				
GROUP 3 *		2025-12-22	16.85	6.80	23.65
605	BITUMINOUS DISTRIBUTOR DRIVER				
606	BITUMINOUS DISTRIBUTOR (ONE PERSON OPERATION)				
607	THREE AXLE UNITS				
GROUP 4 *		2025-12-22	25.71	8.71	34.42
608	BITUMINOUS DISTRIBUTOR SPRAY OPERATOR (REAR AND OILER)				
609	DUMP PERSON				
610	GREASER				
611	PILOT CAR DRIVER				
612	RUBBER-TIRED, SELF-PROPELLED PACKER UNDER 8 TONS				
613	TWO AXLE UNIT				
614	SLURRY OPERATOR				
615	TANK TRUCK HELPER (GAS, OIL, ROAD OIL, AND WATER)				
616	TRACTOR OPERATOR, UNDER 50 H.P.				
SPECIAL CRAFTS					
701	HEATING AND FROST INSULATORS	2025-12-22	55.34	33.85	89.19

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
		2026-06-08	59.39	33.85	93.24
702*	BOILERMAKERS	2025-12-22	46.00	31.93	77.93
703	BRICKLAYERS	2025-12-22	49.98	28.26	78.24
		2026-05-04	52.98	28.26	81.24
704*	CARPENTERS	2025-12-22	43.70	27.40	71.10
		2026-05-04	46.81	27.40	74.21
705*	CARPET LAYERS (LINOLEUM)	2025-12-22	43.00	26.76	69.76
		2026-06-01	45.91	26.76	72.67
706	CEMENT MASONS	2025-12-22	53.34	15.43	68.77
		2026-05-01	56.09	15.43	71.52
707	ELECTRICIANS	2025-12-22	49.49	27.25	76.74
708*	ELEVATOR CONSTRUCTORS	2025-12-22	62.52	45.36	107.88
		2026-01-01	65.21	46.21	111.42
709*	GLAZIERS	2025-12-22	39.24	13.46	52.70
710*	LATHERS	2025-12-22	43.70	27.35	71.05
		2026-05-04	46.81	27.35	74.16
712	IRONWORKERS	2025-12-22	46.35	37.86	84.21
		2026-05-03	49.50	37.86	87.36
714*	MILLWRIGHT	2025-12-22	42.95	37.81	80.76
		2026-05-01	46.15	37.81	83.96
715*	PAINTERS (INCLUDING HAND BRUSHED, HAND SPRAYED, AND THE TAPING OF PAVEMENT MARKINGS)	2025-12-22	35.28	26.16	61.44
716*	PILEDRIVER (INCLUDING VIBRATORY DRIVER OR EXTRACTOR FOR PILING AND SHEETING OPERATIONS)	2025-12-22	47.71	31.98	79.69

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
717*	PIPEFITTERS . STEAMFITTERS	2025-12-22	49.91	33.58	83.49
		2026-05-01	54.91	33.58	88.49
718*	PLASTERERS	2025-12-22	43.00	19.96	62.96
		2026-06-01	45.33	19.96	65.29
719*	PLUMBERS	2025-12-22	44.11	19.50	63.61
720*	ROOFER	2025-12-22	31.96	20.15	52.11
		2026-06-01	34.46	20.15	54.61
721	SHEET METAL WORKERS	2025-12-22	40.03	28.98	69.01
		2026-05-01	43.53	28.98	72.51
722*	SPRINKLER FITTERS	2025-12-22	45.93	27.26	73.19
		2026-04-01	48.71	28.56	77.27
723*	TERRAZZO WORKERS	2025-12-22	40.53	19.83	60.36
724*	TILE SETTERS	2025-12-22	45.25	0.91	46.16
725*	TILE FINISHERS	2025-12-22	30.76	6.02	36.78
726	DRYWALL TAPER	2025-12-22	34.94	26.49	61.43
727*	WIRING SYSTEM TECHNICIAN	2025-12-22	51.07	24.02	75.09
		2026-07-02	54.44	24.02	78.46
728*	WIRING SYSTEMS INSTALLER	2025-12-22	35.78	19.15	54.93
		2026-07-02	38.15	19.15	57.30
729*	ASBESTOS ABATEMENT WORKER	2025-12-22	41.23	25.99	67.22
730*	SIGN ERECTOR	2025-12-22	34.91	20.31	55.22

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MINNESOTA DEPARTMENT OF LABOR AND INDUSTRY PREVAILING WAGES FOR STATE FUNDED CONSTRUCTION PROJECTS

THIS NOTICE MUST BE POSTED ON THE JOBSITE IN A CONSPICUOUS PLACE

Construction Type: Highway and Heavy

Region Number: 06

Counties within region:

- DODGE-20
- FILLMORE-23
- FREEBORN-24
- GOODHUE-25
- HOUSTON-28
- MOWER-50
- OLMSTED-55
- RICE-66
- STEELE-74
- WABASHA-79
- WINONA-85

Effective: 2025-11-03 Revised: 2025-12-01

This project is covered by Minnesota prevailing wage statutes. Wage rates listed below are the minimum hourly rates to be paid on this project.

All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at a rate of one and one half (1 1/2) times the basic hourly rate. *Note: Overtime pay after eight (8) hours on the project must be paid even if the worker does not exceed forty (40) hours in the work week.*

Violations on MnDOT highways and road projects should be reported to:

Department of Transportation
Office of Construction
Transportation Building MS650
John Ireland Blvd
St. Paul, MN 55155
(651) 366-4209

All other prevailing wage violations and questions should be sent to:

Department of Labor and Industry
Prevailing Wage Section
443 Lafayette Road N
St Paul, MN 55155
(651) 284-5091
DLI.PrevWage@state.mn.us

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
LABORERS (101 - 112) (SPECIAL CRAFTS 701 - 730)					
101	LABORER, COMMON (GENERAL LABOR WORK)	2025-11-03	39.01	26.01	65.02
102	LABORER, SKILLED (ASSISTING SKILLED CRAFT JOURNEYMAN)	2025-11-03	39.01	26.01	65.02

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
103	LABORER, LANDSCAPING (GARDENER, SOD LAYER AND NURSERY OPERATOR)	2025-11-03	31.66	22.78	54.44
104	FLAG PERSON	2025-11-03	39.01	26.01	65.02
105	WATCH PERSON	2025-11-03	29.11	22.19	51.30
106	BLASTER	2025-11-03	42.01	26.01	68.02
107	PIPELAYER (WATER, SEWER AND GAS)	2025-11-03	42.51	26.01	68.52
108	TUNNEL MINER	2025-11-03	33.51	22.39	55.90
109	UNDERGROUND AND OPEN DITCH LABORER (EIGHT FEET BELOW STARTING GRADE LEVEL)	2025-11-03	40.51	26.01	66.52
110	SURVEY FIELD TECHNICIAN (OPERATE TOTAL STATION, GPS RECEIVER, LEVEL, ROD OR RANGE POLES, STEEL TAPE MEASUREMENT; MARK AND DRIVE STAKES; HAND OR POWER DIGGING FOR AND IDENTIFICATION OF MARKERS OR MONUMENTS; PERFORM AND CHECK CALCULATIONS; REVIEW AND UNDERSTAND CONSTRUCTION PLANS AND LAND SURVEY MATERIALS). THIS CLASSIFICATION DOES NOT APPLY TO THE WORK PERFORMED ON A PREVAILING WAGE PROJECT BY A LAND SURVEYOR WHO IS LICENSED PURSUANT TO MINNESOTA STATUTES, SECTIONS 326.02 TO 326.15.	2025-11-03	28.18	20.07	48.25
111	TRAFFIC CONTROL PERSON (TEMPORARY SIGNAGE)	2025-11-03	26.42	0.08	26.50
112	QUALITY CONTROL TESTER (FIELD AND COVERED OFF-SITE FACILITIES; TESTING OF AGGREGATE, ASPHALT, AND CONCRETE MATERIALS); LIMITED TO MN DOT HIGHWAY AND HEAVY CONSTRUCTION PROJECTS WHERE THE MN DOT HAS RETAINED QUALITY ASSURANCE PROFESSIONALS TO REVIEW AND	2025-11-03	19.70	0.13	19.83

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
	INTERPRET THE RESULTS OF QUALITY CONTROL TESTERS. SERVICES PROVIDED BY THE CONTRACTOR.				
SPECIAL EQUIPMENT (201 - 204)					
201	ARTICULATED HAULER	2025-11-03	46.25	29.40	75.65
		2026-05-04	47.68	31.00	78.68
202	BOOM TRUCK	2025-11-03	48.96	29.40	78.36
203	LANDSCAPING EQUIPMENT, INCLUDES HYDRO SEEDER OR MULCHER, SOD ROLLER, FARM TRACTOR WITH ATTACHMENT SPECIFICALLY SEEDING, SODDING, OR PLANT, AND TWO-FRAMED FORKLIFT (EXCLUDING FRONT, POSIT-TRACK, AND SKID STEER LOADERS), NO EARTHWORK OR GRADING FOR ELEVATIONS	2025-11-03	41.37	29.40	70.77
		2026-05-04	42.60	31.00	73.60
204	OFF-ROAD TRUCK	2025-11-03	44.67	26.40	71.07
205	PAVEMENT MARKING OR MARKING REMOVAL EQUIPMENT (ONE OR TWO PERSON OPERATORS); SELF-PROPELLED TRUCK OR TRAILER MOUNTED UNITS.	2025-11-03	33.91	23.49	57.40
HIGHWAY/HEAVY POWER EQUIPMENT OPERATOR					
GROUP 2		2025-11-03	47.24	29.40	76.64
		2026-05-04	48.71	31.00	79.71
302	HELICOPTER PILOT (HIGHWAY AND HEAVY ONLY)				
303	CONCRETE PUMP (HIGHWAY AND HEAVY ONLY)				
304	ALL CRANES WITH OVER 135-FOOT BOOM, EXCLUDING JIB (HIGHWAY AND HEAVY ONLY)				
305	DRAGLINE, CRAWLER, HYDRAULIC BACKHOE (TRACK OR WHEEL MOUNTED) AND/OR OTHER SIMILAR EQUIPMENT WITH SHOVEL-TYPE CONTROLS THREE CUBIC YARDS AND OVER MANUFACTURER.S RATED CAPACITY INCLUDING ALL ATTACHMENTS. (HIGHWAY AND HEAVY ONLY)				
306	GRADER OR MOTOR PATROL				
307	PILE DRIVING (HIGHWAY AND HEAVY ONLY)				
308	TUGBOAT 100 H.P. AND OVER WHEN LICENSE REQUIRED (HIGHWAY AND HEAVY ONLY)				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
GROUP 3		2025-11-03	46.61	29.40	76.01
		2026-05-04	48.05	31.00	79.05
309	ASPHALT BITUMINOUS STABILIZER PLANT				
310	CABLEWAY				
311	CONCRETE MIXER, STATIONARY PLANT (HIGHWAY AND HEAVY ONLY)				
312	DERRICK (GUY OR STIFFLEG)(POWER)(SKIDS OR STATIONARY) (HIGHWAY AND HEAVY ONLY)				
313	DRAGLINE, CRAWLER, HYDRAULIC BACKHOE (TRACK OR WHEEL MOUNTED) AND/OR SIMILAR EQUIPMENT WITH SHOVEL-TYPE CONTROLS, UP TO THREE CUBIC YARDS MANUFACTURER.S RATED CAPACITY INCLUDING ALL ATTACHMENTS (HIGHWAY AND HEAVY ONLY)				
314	DREDGE OR ENGINEERS, DREDGE (POWER) AND ENGINEER				
315	FRONT END LOADER, FIVE CUBIC YARDS AND OVER INCLUDING ATTACHMENTS. (HIGHWAY AND HEAVY ONLY)				
316	LOCOMOTIVE CRANE OPERATOR				
317	MIXER (PAVING) CONCRETE PAVING, ROAD MOLE, INCLUDING MUCKING OPERATIONS, CONWAY OR SIMILAR TYPE				
318	MECHANIC . WELDER ON POWER EQUIPMENT (HIGHWAY AND HEAVY ONLY)				
319	TRACTOR . BOOM TYPE (HIGHWAY AND HEAVY ONLY)				
320	TANDEM SCRAPER				
321	TRUCK CRANE . CRAWLER CRANE (HIGHWAY AND HEAVY ONLY)				
322	TUGBOAT 100 H.P AND OVER (HIGHWAY AND HEAVY ONLY)				
GROUP 4		2025-11-03	46.25	29.40	75.65
		2026-05-04	47.68	31.00	78.68
323	AIR TRACK ROCK DRILL				
324	AUTOMATIC ROAD MACHINE (CMI OR SIMILAR) (HIGHWAY AND HEAVY ONLY)				
325	BACKFILLER OPERATOR				
326	CONCRETE BATCH PLANT OPERATOR (HIGHWAY AND HEAVY ONLY)				
327	BITUMINOUS ROLLERS, RUBBER TIRED OR STEEL DRUMMED (EIGHT TONS AND OVER)				
328	BITUMINOUS SPREADER AND FINISHING MACHINES (POWER), INCLUDING PAVERS, MACRO SURFACING AND MICRO SURFACING, OR SIMILAR TYPES (OPERATOR AND SCREED PERSON)				
329	BROKK OR R.T.C. REMOTE CONTROL OR SIMILAR TYPE WITH ALL ATTACHMENTS				
330	CAT CHALLENGER TRACTORS OR SIMILAR TYPES PULLING ROCK WAGONS, BULLDOZERS AND SCRAPERS				
331	CHIP HARVESTER AND TREE CUTTER				
332	CONCRETE DISTRIBUTOR AND SPREADER FINISHING MACHINE, LONGITUDINAL FLOAT, JOINT MACHINE, AND SPRAY MACHINE				
333	CONCRETE MIXER ON JOBSITE (HIGHWAY AND HEAVY ONLY)				
334	CONCRETE MOBIL (HIGHWAY AND HEAVY ONLY)				
335	CRUSHING PLANT (GRAVEL AND STONE) OR GRAVEL WASHING, CRUSHING AND SCREENING PLANT				
336	CURB MACHINE				
337	DIRECTIONAL BORING MACHINE				
338	DOPE MACHINE (PIPELINE)				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
339	DRILL RIGS, HEAVY ROTARY OR CHURN OR CABLE DRILL (HIGHWAY AND HEAVY ONLY)				
340	DUAL TRACTOR				
341	ELEVATING GRADER				
342	FORK LIFT OR STRADDLE CARRIER (HIGHWAY AND HEAVY ONLY)				
343	FORK LIFT OR LUMBER STACKER (HIGHWAY AND HEAVY ONLY)				
344	FRONT END, SKID STEER OVER 1 TO 5 C YD				
345	GPS REMOTE OPERATING OF EQUIPMENT				
346	HOIST ENGINEER (POWER) (HIGHWAY AND HEAVY ONLY)				
347	HYDRAULIC TREE PLANTER				
348	LAUNCHER PERSON (TANKER PERSON OR PILOT LICENSE)				
349	LOCOMOTIVE (HIGHWAY AND HEAVY ONLY)				
350	MILLING, GRINDING, PLANNING, FINE GRADE, OR TRIMMER MACHINE				
351	MULTIPLE MACHINES, SUCH AS AIR COMPRESSORS, WELDING MACHINES, GENERATORS, PUMPS (HIGHWAY AND HEAVY ONLY)				
352	PAVEMENT BREAKER OR TAMPING MACHINE (POWER DRIVEN) MIGHTY MITE OR SIMILAR TYPE				
353	PICKUP SWEEPER, ONE CUBIC YARD AND OVER HOPPER CAPACITY(HIGHWAY AND HEAVY ONLY)				
354	PIPELINE WRAPPING, CLEANING OR BENDING MACHINE				
355	POWER PLANT ENGINEER, 100 KWH AND OVER (HIGHWAY AND HEAVY ONLY)				
356	POWER ACTUATED HORIZONTAL BORING MACHINE, OVER SIX INCHES				
357	PUGMILL				
358	PUMPCRETE (HIGHWAY AND HEAVY ONLY)				
359	RUBBER-TIRED FARM TRACTOR WITH BACKHOE INCLUDING ATTACHMENTS (HIGHWAY AND HEAVY ONLY)				
360	SCRAPER				
361	SELF-PROPELLED SOIL STABILIZER				
362	SLIP FORM (POWER DRIVEN) (PAVING)				
363	TIE TAMPER AND BALLAST MACHINE				
364	TRACTOR, BULLDOZER (HIGHWAY AND HEAVY ONLY)				
365	TRACTOR, WHEEL TYPE, OVER 50 H.P. WITH PTO UNRELATED TO LANDSCAPING (HIGHWAY AND HEAVY ONLY)				
366	TRENCHING MACHINE (SEWER, WATER, GAS) EXCLUDES WALK BEHIND TRENCHER (HIGHWAY AND HEAVY ONLY)				
367	TUB GRINDER, MORBARK, OR SIMILAR TYPE				
368	WELL POINT DISMANTLING OR INSTALLATION (HIGHWAY AND HEAVY ONLY)				
GROUP 5		2025-11-03	42.77	29.40	72.17
		2026-05-04	44.06	31.00	75.06
369	AIR COMPRESSOR, 600 CFM OR OVER (HIGHWAY AND HEAVY ONLY)				
370	BITUMINOUS ROLLER (UNDER EIGHT TONS)				
371	CONCRETE SAW (MULTIPLE BLADE) (POWER OPERATED)				
372	FORM TRENCH DIGGER (POWER)				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
373	FRONT END, SKID STEER UP TO 1C YD				
374	GUNITE GUNALL (HIGHWAY AND HEAVY ONLY)				
375	HYDRAULIC LOG SPLITTER				
376	LOADER (BARBER GREENE OR SIMILAR TYPE)				
377	POST HOLE DRIVING MACHINE/POST HOLE AUGER				
378	POWER ACTUATED AUGER AND BORING MACHINE				
379	POWER ACTUATED JACK				
380	PUMP (HIGHWAY AND HEAVY ONLY)				
381	SELF-PROPELLED CHIP SPREADER (FLAHERTY OR SIMILAR)				
382	SHEEP FOOT COMPACTOR WITH BLADE . 200 H.P. AND OVER				
383	SHOULDERING MACHINE (POWER) APSCO OR SIMILAR TYPE INCLUDING SELF-PROPELLED SAND AND CHIP SPREADER				
384	STUMP CHIPPER AND TREE CHIPPER				
385	TREE FARMER (MACHINE)				
GROUP 6		2025-11-03	41.37	29.40	70.77
		2026-05-04	42.60	31.00	73.60
387	CAT, CHALLENGER, OR SIMILAR TYPE OF TRACTORS, WHEN PULLING DISK OR ROLLER				
388	CONVEYOR (HIGHWAY AND HEAVY ONLY)				
389	DREDGE DECK HAND				
390	FIRE PERSON OR TANK CAR HEATER (HIGHWAY AND HEAVY ONLY)				
391	GRAVEL SCREENING PLANT (PORTABLE NOT CRUSHING OR WASHING)				
392	GREASER (TRACTOR) (HIGHWAY AND HEAVY ONLY)				
393	LEVER PERSON				
394	OILER (POWER SHOVEL, CRANE, TRUCK CRANE, DRAGLINE, CRUSHERS, AND MILLING MACHINES, OR OTHER SIMILAR HEAVY EQUIPMENT) (HIGHWAY AND HEAVY ONLY)				
395	POWER SWEEPER				
396	SHEEP FOOT ROLLER AND ROLLERS ON GRAVEL COMPACTION, INCLUDING VIBRATING ROLLERS				
397	TRACTOR, WHEEL TYPE, OVER 50 H.P., UNRELATED TO LANDSCAPING				
TRUCK DRIVERS					
GROUP 1		2025-11-03	38.80	24.70	63.50
		2026-05-01	40.64	25.40	66.04
601	MECHANIC . WELDER				
602	TRACTOR TRAILER DRIVER				
603	TRUCK DRIVER (HAULING MACHINERY INCLUDING OPERATION OF HAND AND POWER OPERATED WINCHES)				
GROUP 2		2025-11-03	38.16	24.70	62.86
		2026-05-01	39.97	25.40	65.37

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
604	FOUR OR MORE AXLE UNIT, STRAIGHT BODY TRUCK				
GROUP 3		2025-11-03	35.50	21.75	57.25
605	BITUMINOUS DISTRIBUTOR DRIVER				
606	BITUMINOUS DISTRIBUTOR (ONE PERSON OPERATION)				
607	THREE AXLE UNITS				
GROUP 4		2025-11-03	35.74	21.76	57.50
608	BITUMINOUS DISTRIBUTOR SPRAY OPERATOR (REAR AND OILER)				
609	DUMP PERSON				
610	GREASER				
611	PILOT CAR DRIVER				
612	RUBBER-TIRED, SELF-PROPELLED PACKER UNDER 8 TONS				
613	TWO AXLE UNIT				
614	SLURRY OPERATOR				
615	TANK TRUCK HELPER (GAS, OIL, ROAD OIL, AND WATER)				
616	TRACTOR OPERATOR, UNDER 50 H.P.				
SPECIAL CRAFTS					
701	HEATING AND FROST INSULATORS	2025-11-03	43.90	23.05	66.95
702	BOILERMAKERS	2025-11-03	48.35	31.93	80.28
703	BRICKLAYERS	2025-11-03	36.05	19.68	55.73
704	CARPENTERS	2025-11-03	47.57	32.17	79.74
		2026-05-01	50.76	32.17	82.93
705	CARPET LAYERS (LINOLEUM)	2025-11-03	35.32	14.03	49.35
706	CEMENT MASONS	2025-11-03	56.13	14.34	70.47
707	ELECTRICIANS	2025-11-03	49.49	27.25	76.74
711	GROUND PERSON	2025-11-03	33.40	16.30	49.70
712	IRONWORKERS	2025-11-03	46.35	37.86	84.21
		2026-05-03	49.50	37.86	87.36
713	LINEMAN	2025-11-03	46.32	20.12	66.44

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
714	MILLWRIGHT	2025-11-03	41.70	31.81	73.51
715	PAINTERS (INCLUDING HAND BRUSHED, HAND SPRAYED, AND THE TAPING OF PAVEMENT MARKINGS)	2025-11-03	48.00	29.09	77.09
		2026-05-04	50.50	29.09	79.59
716	PILEDRIVER (INCLUDING VIBRATORY DRIVER OR EXTRACTOR FOR PILING AND SHEETING OPERATIONS)	2025-11-03	47.71	31.98	79.69
		2026-05-01	50.90	31.98	82.88
717	PIPEFITTERS . STEAMFITTERS	2025-11-03	59.09	36.45	95.54
		2026-05-01	64.09	36.45	100.54
719	PLUMBERS	2025-11-03	49.91	33.58	83.49
721	SHEET METAL WORKERS	2025-11-03	57.96	34.57	92.53
723	TERRAZZO WORKERS	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
724	TILE SETTERS	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
725	TILE FINISHERS	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
727	WIRING SYSTEM TECHNICIAN	2025-11-03	51.07	23.52	74.59
728	WIRING SYSTEMS INSTALLER	2025-11-03	26.49	12.40	38.89
729	ASBESTOS ABATEMENT WORKER	2025-11-03	36.23	22.26	58.49
730	SIGN ERECTOR	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			

TO BE PRINTED ON CONTRACTOR'S LETTERHEAD

LETTER OF TRANSMITTAL

Contractor Name

Contractor Address

Contractor City, State, Zip

DATE:	BMI # 0M2.131536
ATTENTION:	
RE: Wastewater Treatment Facility Improvements	
City of Spring Valley, Minnesota	
SUBMITTAL NO.:	

WE ARE SENDING YOU ☐ Attached ☐ Under separate cover via ___ the following items:

☐ Shop drawings ☐ Prints ☐ Specifications ☐ Copy of letter

☐ _____

No. Copies Submitted	Specification Section	Subject of Shop Drawing or Other Submittal

Review Action: *(To be filled in by Engineer)*

☐ No Exceptions Taken ☐ Amend-Resubmit ☐ Not Reviewed

☐ Make Corrections Noted ☐ Rejected-Resubmit ☐ For Record

Corrections or comments made on Contractor's submittals during this review do not relieve the Contractor from compliance with Contract drawings and Specifications. This submittal has been reviewed for conformance with the design concept and general compliance with the Contract documents only. Contactor is responsible for confirming and correlating all quantities and dimensions; fabrication processes and techniques, coordinating work with other trades, and satisfactory and safe performance of the work.

Comments: *(To be filled in by Engineer)*

☐ The CONTRACTOR hereby notifies the OWNER that this Shop Drawing is in conformance with Article 7 of the General Conditions to the Contract Documents.

☐ The CONTRACTOR hereby notifies the OWNER that this Shop Drawing is not in conformance with Article 7 of the General Conditions to the Contract Documents and nevertheless asks approval thereof. The features not in conformance are as follows:

1. _____
2. _____
3. _____

CONTRACTOR SIGNED: _____

DATE: _____

(To be filled in by Engineer)

COPY TO: _____

_____

ENGINEER SIGNED: _____

DATE: _____

Distribution: ☐ Contractor ☐ Owner ☐ Proj. Engr. ☐ Field Office ☐ Other

SECTION 00 63 00 - PROPOSAL REQUEST

PROPOSAL REQUEST

- ☐ OWNER
- ☐ ENGINEER
- ☐ CONSULTANTS
- ☐ CONTRACTOR
- ☐ FIELD
- ☐ OTHER

PROJECT:
(name, address)

PROPOSAL REQUEST NO:

OWNER:

DATE:

TO: (CONTRACTOR)

ENGINEER'S PROJECT NO:

CONTRACT FOR:

CONTRACT DATED:

Please submit an itemized quotation for changes in the Contract Sum and/or Time incidental to proposed modifications to the Contract Documents described herein.

THIS IS NOT A CHANGE ORDER NOR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED HEREIN.

Description: (Written Description of the Work)

Attachments: (List Attached Documents that Support Description)

ENGINEER:

DATE:

FIELD ORDER FORM

NO.: _____

Owner:	City of Spring Valley	Owner's Project No.:	
Engineer:	Bolton & Menk, Inc.	Engineer's Project No.:	0M2.131536
Contractor:		Contractor's Project No.:	
Project:	Wastewater Treatment Facility Improvements		
Contract Name:			
Date Issued:		Effective Date of Field Order:	

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with Paragraph 11.04 of the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

[Description of the change to the Work]

Attachments:

[List documents supporting change]

Issued by Engineer

By: _____

Title: _____

Date: _____

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WORK CHANGE DIRECTIVE FORM

NO.: _____

Owner:	City of Spring Valley, MN	Owner's Project No.:	
Engineer:	Bolton & Menk, Inc.	Engineer's Project No.:	0M2.131536
Contractor:		Contractor's Project No.:	
Project:	Wastewater Treatment Facility Improvements		
Contract Name:			
Date Issued:		Effective Date of Work Change Directive:	

Contractor is directed to proceed promptly with the following change(s):

Description:

[Description of the change to the Work]

Attachments:

[List documents related to the change to the Work]

Purpose for the Work Change Directive:

[Describe the purpose for the change to the Work]

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following

☒ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: $_____ **[increase] [decrease] [not yet estimated]**.

Contract Time: _____ days **[increase] [decrease] [not yet estimated]**.

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

	Recommended by Engineer	Authorized by Owner
By:	_____	_____
Title:	_____	_____
Date:	_____	_____

CHANGE ORDER FORM

NO.: _____

Owner:	City of Spring Valley	Owner's Project No.:	
Engineer:	Bolton & Menk, Inc.	Engineer's Project No.:	0M2.131536
Contractor:		Contractor's Project No.:	
Project:	Wastewater Treatment Facility Improvements		
Contract Name:			
Date Issued:		Effective Date of Change Order:	

The Contract is modified as follows upon execution of this Change Order:

Description:

[Description of the change]

Attachments:

[List documents related to the change]

Change in Contract Price	**Change in Contract Times [State Contract Times as either a specific date or a number of days]**
Original Contract Price: $ _____	Original Contract Times: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**: $ _____	**[Increase] [Decrease]** from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**: Substantial Completion: _____ Ready for final payment: _____
Contract Price prior to this Change Order: $ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] this Change Order: $ _____	**[Increase] [Decrease]** this Change Order: Substantial Completion: _____ Ready for final payment: _____
Contract Price incorporating this Change Order: $ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for final payment: _____

	Recommended by Engineer (if required)	Accepted by Contractor
By:	_____	_____
Title:	_____	_____
Date:	_____	_____
	Authorized by Owner	Approved by Funding Agency (if applicable)
By:	_____	_____
Title:	_____	_____
Date:	_____	_____

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CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	City of Spring Valley, Minnesota	Owner's Project No.:	
Engineer:	Bolton & Menk, Inc.	Engineer's Project No.:	0M2.131536
Contractor:		Contractor's Project No.:	
Project:	Wastewater Treatment Facility Improvements		
Contract Name:			

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work: Fully operational wastewater treatment facility.

Date of Substantial Completion: [Enter date, as determined by Engineer]

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities:☐ None ☐ As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

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SECTION 01 11 00 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 GENERAL

A. The WORK to be performed under this Contract shall consist of furnishing all plant, tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The WORK shall be complete, and all work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be performed, furnished, and installed by the CONTRACTOR as though originally so specified or shown, at no increase in cost to the OWNER.

1.2 PROJECT LOCATION

A. The project is located in the City of Spring Valley, Minnesota, which is located in Filmore County. The project location is shown on the vicinity map in the design drawing set.

1.3 PROJECT DESCRIPTION

A. The work hereafter referred to requires the complete construction and start-up necessary for the facility with all required necessary equipment, generally described, but not limited to, in the following paragraphs:

1. Main lift station and forcemain improvements.
2. Renovation of the existing pretreatment building and replacement of mechanical fine screen equipment.
3. Biological treatment renovations, including concrete basin modifications, new aeration and mixing equipment, new clarifiers and control structures, and submersible pumping.
4. Chemical feed improvements, including replacement of gaseous chlorine and sulfur dioxide equipment and installation of new carbon feed.
5. Construction of a new effluent re-aeration system, including precast structure, positive displacement blower, and aeration equipment.
6. Renovations of the existing aerated solids storage facilities, including new coarse bubble mixing improvements, sludge pumping, and sludge loadout.
7. Renovation to other existing buildings, including the disinfection, digestion, and administration buildings. Construction of a new masonry building for electrical equipment.
8. Decommissioning and demolition of existing processes as required.
9. Site work, utility, and pavement improvements.
10. Electrical, instrumentation, control, and SCADA system improvements.

1.4 ORDER OF THE WORK

A. The work shall be carried out at such places on the project and also in such order or precedence as may be found necessary by the Engineer to expedite the completion of the project. After work has begun on any portion of the project, it shall be carried forward to its final completion. All work shall conform to the provisions of the approved Contractor's schedule.

1.5 INTERFERENCE WITH WORK ON UTILITIES

A. The Contractor shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the work, and shall schedule the work so as to minimize interference with said relocation, altering, or other rearranging of facilities.

1.6 SEQUENCE OF CONSTRUCTION

A. The Contractor shall at all times conduct his operations so as to minimize any impact on existing treatment processes. At no time shall the Contractor's operations cause the OWNER to abandon any portion of the treatment process.

B. The Contractor shall coordinate all process interruptions with the OWNER, Engineer, and operations staff. All construction shall be coordinated with the plant operations staff at all times. Any night work and overtime payments that may be required for modifications performed at low flow shall be considered to have been included in the price bid for work.

C. Refer to Section 01 32 00 - Sequence of Construction, for additional information and requirements.

1.7 CONTRACTOR USE OF PROJECT SITE

A. The CONTRACTOR's use of the project site shall be limited to its construction operations, including on-site storage of materials, on-site fabrication facilities, and field offices.

1.8 OWNER USE OF THE PROJECT SITE

A. The OWNER may utilize all or part of the existing site and existing facilities during the entire period of construction. The CONTRACTOR shall cooperate with the OWNER to minimize interference with the CONTRACTOR's operations and to facilitate the OWNER's operations. In any event, the OWNER shall be allowed access to the project site during the period of construction.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 13 10 - COORDINATION

PART 1 -- GENERAL

1.1 SEQUENCE OF CONSTRUCTION

A. A project management network scheduling tool (i.e., critical path (CPM), etc.) or a DETAILED bar chart shall be employed by the Contractor for cost value reporting, planning, and scheduling of all work required under the Contract Documents. This schedule shall show the order in which the Contractor proposes to execute the work with dates on which it proposes to start the various phases of the work and the estimated completion date of each phase. The Contractor shall submit a preliminary version of its intended schedule within 10 working days following the *Notice of Award* on a form of its own choosing.

B. Unless otherwise approved by the Engineer, the schedule shall also include an anticipated payment schedule for the volume of work to be completed each month. This schedule shall indicate the Contractor's intention and ability to complete the work within the contract times, as specified in Article 3 of the Agreement.

C. The Preconstruction Conference will not be conducted until the schedule is submitted. In addition, no construction staking shall be provided until the schedule is submitted by the Contractor and reviewed by the Engineer.

1.2 WORKING HOURS

A. Except in connection with safety or emergency situations, all work at the site shall be performed from 7 AM to 7 PM, Monday through Friday.

B. The Contractor shall notify the Owner and Engineer of any work planned on Saturday, Sunday, or any legal holiday at least 48 hours prior to such work.

C. The Contractor shall coordinate with OWNER any construction or hauling activity in the vicinity of churches, schools, medical facilities, and funeral homes. The Contractor shall be cognizant of the disruptive effects of continued construction during funerals. The Owner reserves the right to temporarily stop construction within one block of, and during the time of, any funeral procession. No compensation shall be granted to the Contractor due to temporary delays caused by funerals.

1.3 COORDINATION WITH UTILITY COMPANIES

A. The contractor is responsible for working with public and private utility companies in protecting and/or relocating existing or new utility lines located near and affected by this construction.

1. Coordination with the utility companies is very important and should be considered in planning the work and the associated extra costs involved.

2. Private utility companies are responsible for their own lines and are so obligated under City Code Agreements to protect and/or relocate their utilities if required by the City (Owner).

B. The Contractor shall also work with the City's maintenance personnel to provide for scheduled water shutdowns in a given area and to provide for continued water service to the properties included in the project throughout the duration of the project.

C. The Contractor shall work with all utility companies, as necessary, to allow for installation and for maintenance of service of gas, power, lighting, telephone, cable TV, etc. in the boulevards or across

the streets prior to final shaping of aggregate base and/or topsoil. This coordination with the utility companies is the responsibility of the Contractor and is considered incidental to the construction and no additional compensation shall be granted.

1.4 COOPERATION WITH OTHER CONTRACTORS

A. The Contractor shall cooperate with other contractors performing construction on other projects in the vicinity of this project, including but not limited to allowing access for the delivery of equipment and materials.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

****END OF SECTION****

SECTION 01 21 00 – ALLOWANCES

PART 1 -- GENERAL

1.1 GENERAL

A. Contractor shall include in total base bid allowances as specified in this Section.

1.2 DEFINITION OF ALLOWANCES

A. General Construction Allowance: Allowance to be utilized for payment of miscellaneous project changes. Use of allowance requires Engineer approval of project changes and associated costs. Contractor markup is allowed in accordance with the General Conditions.

B. Computer Allowance: Computer allowance will be utilized for computers and appurtenance accessories specified in Section 26 90 02 - Wastewater Treatment Control System. Sales tax for computers and accessories shall be paid out of the allowance. Installation, contractor markup, and any additional work-related items associated with this equipment shall be included in the lump sum bid price.

C. Laboratory Equipment Allowance: Allowance for lab equipment will be utilized for equipment not scheduled in Section 11 53 00 - Laboratory Equipment. Sales tax for equipment shall be paid out of the allowance. The Owner will select additional equipment to be paid for with the allowance. All items scheduled in Section 11 53 00 shall be included in the Wastewater Treatment Facilities construction bid item.

D. Furnishings Allowance: Allowance will be utilized for furnishings selected by the Owner in Section 12 50 00 - Furnishings. Sales tax for furnishings shall be paid for out of the allowance.

E. Submersible Pump Allowance: Allowance to be utilized for furnishing the submersible pump equipment as specified in Section 43 25 00 – Submersible Centrifugal Pumps. Sales tax for equipment shall be paid out of the allowance. Installation, contractor markup, and any additional work-related items associated with the submersible pump equipment shall be included in the lump sum bid price.

F. Utility Service Connections Allowance: Allowance to be utilized for payment of connection of utility services not specified or shown on plans. Use of allowance requires Engineer approval of project changes and associated costs. Contractor markup, coordination, and additional work-related items associated with the utility service connections shall be included in the lump sum bid price.

G. Building Permit Allowance: Allowance will be utilized for payment of the Owner-issued building permit. All other required permits will be considered incidental to the contract.

H. No contractor markup allowed on equipment, furnishings, computer, or utility allowance. Normal contractor markup per General Conditions allowed for general construction allowance items.

1.3 SCHEDULE OF ALLOWANCE/VALUES

A.	General Construction Allowance:	$400,000
B.	Computer Allowance:	$50,000
C.	Laboratory Equipment Allowance:	$25,000
D.	Furnishings Allowance:	$25,000
E.	Submersible Pump Allowance:	$300,000

F. Utility Service Connections Allowance: $50,000

G. Building Permit Allowance: $25,000

H. Total Allowance to be Included in Base Bid: $875,000

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 29 00 - MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.1 SCHEDULE OF VALUES

A. Within ten days after the Effective Date of the Agreement, the CONTRACTOR shall prepare and submit to the ENGINEER for approval, a detailed Schedule of Values or costs by a breakdown by major specification sections of the total contract price. The Schedule of Values shall be sufficiently detailed to provide a basis for progress payments.

1.2 REQUEST FOR PAYMENTS

A. Applications for payment shall be submitted in accordance with the Schedule of Values and General Conditions and shall be submitted on forms approved by the ENGINEER. Application for payment shall be made at least two days prior to the monthly Construction Progress Meeting.

B. The CONTRACTOR shall furnish the ENGINEER promptly, upon request, with all information and records necessary to determine the cost of the work for purposes of estimating monthly payments, including a satisfactory itemized statement of the actual cost of all acceptable materials delivered by the CONTRACTOR to the site as required by the General Conditions.

1.3 ENGINEER'S PAY ESTIMATE

A. On or about the 25th day of each month, the ENGINEER will prepare and certify to the OWNER, an estimate of the cumulative amount and value of work performed by the CONTRACTOR up to that date. Said amount will include all acceptable materials and equipment delivered to the site of the work as defined in the General Conditions. The said value will be based on certified copies of invoices delivered by the CONTRACTOR to the ENGINEER. To this figure will be added all amounts due or paid to the CONTRACTOR for the performance of extra work in accordance with change orders.

B. The ENGINEER's estimate of the monthly payment due to the CONTRACTOR will not be required to be made by strict measurement, and an approximate estimate will suffice. The monthly payments may be withheld or reduced if in the ENGINEER's opinion, the CONTRACTOR is not diligently or efficiently endeavoring to comply with the intent of the contract, or if the CONTRACTOR fails to pay his labor and material bills as they become due.

C. No monthly payment shall be construed as an acceptance of the work or of any portion of the work, nor shall the making of such payment preclude the OWNER from demanding and recovering from the CONTRACTOR any damages caused by the CONTRACTOR's failure to comply with the requirements of the Contract.

1.4 PROGRESS PAYMENT

A. Progress payments will become due 30 days after the presentation of the Application for Payment with the ENGINEER's recommendation as required by the General Conditions and as modified by the Supplementary Conditions.

B. The schedule of Progress Payments may be altered by the Agreement or Purchase Order.

1.5 FINAL PAYMENT

A. Final payment will be made as specified in Section 01 77 00 and subject to provisions of the General Conditions and as modified by the Supplementary Conditions.

1.6 CHANGE ORDER PROCEDURES

A. Changes in the Work will be authorized by a written Change Order or Engineer's Field Order.

B. Changes in contract price will be made by a written Change Order.

C. The ENGINEER or OWNER will request an official proposal for change orders.

D. Refer to the General Conditions for change order details.

E. Blank copies of a Change Order, Proposal Request, and Engineer's Field Order are included in the project specifications.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 31 19 - PROJECT MEETINGS

PART 1 -- GENERAL

1.1 PRECONSTRUCTION CONFERENCE

A. Prior to the start of construction, a joint meeting will be held with representatives of the Contractor, the OWNER, the Engineer, and any other interested parties. This meeting is intended to introduce the various key personnel from each organization and to discuss the start of construction, order of work, labor and legal requirements, provisions of State labor laws, insurance requirements, method of payment, weekly payrolls, shop drawing requirements, protection of existing facilities, location of disposal and stockpile areas, and other pertinent items associated with the project.

B. The Contractor shall be required to discuss his proposed detailed construction progress schedule, as presented in Section 01 33 00, and Schedule of Values as required by paragraph 2.05.A.3. of the General Conditions at this conference. All such construction schedules shall be subject to the approval of the Engineer and applicable public agencies.

1.2 CONSTRUCTION PROGRESS MEETINGS

A. Meetings may be held at least monthly or as needed between the OWNER, Contractor, and Engineer for the purpose of reviewing the project schedule, the status of the project, and the Contractor's request for payment.

B. The Contractor shall submit, within at least two working days before the Construction Progress Meeting, a brief written report as to the status of the project in relation to the construction schedule and issues to be discussed at the Construction Progress Meeting.

C. The Contractor shall submit to the Engineer, at least two working days before the monthly progress meeting, a request for payment.

1.3 FINAL PROJECT COMPLETION MEETINGS

A. Final project completion meetings shall be held between the Contractor, OWNER, Engineer, and any other interested parties to determine the final acceptance of the project. The final project completion meeting shall follow the loan or grant issuing agency and state regulatory agency completion of construction policy.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 32 00 - SEQUENCE OF CONSTRUCTION

PART 1 -- GENERAL

1.1 INTERRUPTION OF TREATMENT

A. The Contractor shall at all times conduct his operations so as to minimize any impact on existing treatment processes. The Contractor shall at no time during construction bypass inadequately treated wastewater to surface water or land. Discharge of inadequately treated wastewater and/or bypassing would put the OWNER in violation of their NPDES permit and open to fines imposed by the state regulatory agency. The Contractor shall be responsible for all fines imposed on the OWNER due to Contractor/construction-related NPDES permit violations. At no time shall the Contractor's operations cause the OWNER to abandon any portion of the treatment process to the extent that effluent discharge requirements are violated.

B. The Contractor shall coordinate all process interruptions with the OWNER, Engineer, and operations staff. All construction shall be coordinated with the plant operations staff at all times. Construction shall not proceed until written approval has been given by the Engineer. Any night work and overtime payments required for modifications performed at low flow shall be considered to have been included in the price bid for work.

C. The Contractor shall supply and maintain all pumps and piping necessary for bypass operations.

1.2 SEQUENCE OF CONSTRUCTION

A. General

1. Work under the contract shall be scheduled and performed in such a manner as to result in the least possible disruption to the operation of the existing system or treatment facilities. The Contractor shall submit to the Engineer a construction schedule covering the entire work before any work is commenced. The schedule shall be complete with estimated dates for the start and finish of each item of work. The following construction constraints should be used as a guideline in preparing the scheduling. Deviation from these suggested sequences is permitted if techniques and methods known to the Contractor will result in reducing the disruption of the facility operation and is concurred with by the Engineer.

B. Proposed Sequence / Constraints

1. Main Lift Station / Force Main: This work can be completed independently of work at the WWTF.

2. Pretreatment Building and Fine Screen Replacement: This work can be completed independently of all other work at the WWTF.

3. Disinfection Improvements and Reaeration Basin Construction: This work can be completed independently of all other work at the WWTF.

4. Electrical Building: This structure is required for the operation of the RAS/WAS Pumps and must be completed prior to or concurrent with the Final Clarifier start-up.

5. Final Clarifiers and RAS/WAS Pumping: This work shall be complete and operational prior to any demolition of the existing Aeration Basins/Clarifiers. RAS shall be temporarily returned to the Aeration Basin(s) in service. The existing Mixed Liquor Lift Station can be demolished when the Final Clarifiers and RAS are operational.

6. Aeration Basin Modifications: This work shall be completed with at least 50% of the current aeration capacity available for treatment of CBOD and ammonia. Anoxic Basins and the Mixed Liquor Return system are not required until both Aeration Basins have been modified.

   (a) Route all flow to the North Basin through the existing Control Structure. Remove the South Basin from service and complete clarifier demo, baffle wall demo and construction, aeration improvements, effluent weir, MLR, and effluent channel improvements.

   (b) Return South Basin to service with new Aeration Basins 1B and 2B in operation, and RAS temporarily split to the two basins.

   (c) Remove North Basin from service and complete clarifier demo, baffle wall demo and construction, aeration improvements, jet mix improvements, influent weir, sluice gates, and other Control Structure modifications.

   (d) Isolate Aeration Basins 1B and 2B. Place Aeration Basin 2A in service and drain Basin 1B.

   (e) Core drill/cut openings between 1A and 1B.

   (f) Place Aeration Basins 1A and 1B in service with RAS to Control Structure No. 1. Dewater Basin 2B.

   (g) Core drill/cut openings between 2A and 2B.

   (h) Place all basins in service.

   (i) Begin utilizing Mixed Liquor Return pumps.

7. Sludge Improvements: This work can be completed independently of all other work at the WWTF. One sludge tank shall remain in service and operational at all times. Contents are lowest following the fall land application.

8. Administration Building Improvements: This work can be completed independently of work at the WWTF.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

***** END OF SECTION *****

SECTION 01 33 00 - SUBMITTALS

PART 1 -- GENERAL

1.1 LIST OF SUBCONTRACTORS AND SUPPLIERS

A. Prior to the execution and delivery of the contract, the successful bidder shall submit a complete list of all subcontractors and suppliers with whom he proposes to contract. The list shall be divided into sections corresponding to the specification divisions and shall state the name, address, and telephone numbers, together with work or items to be furnished. The list cannot be revised without written approval by the OWNER. The CONTRACTOR is responsible for compliance with specified requirements by all sub-contractors.

B. This list shall be submitted in addition to or as a supplement to any similar lists required to be submitted with the bid.

1.2 CONSTRUCTION PROGRESS SCHEDULE

A. A project management tool such as a bar chart shall be employed by the CONTRACTOR for cost value reporting, planning, and scheduling of all work required under the Contract Documents.

B. **Time of Submittal:** Within 10 working days after the Effective Date of the Agreement, the CONTRACTOR shall submit for approval of the ENGINEER a bar chart diagram describing the activities to be accomplished in the project and their dependency relationships. The schedule produced and submitted shall indicate a project completion date on or before the contract completion date. The ENGINEER, within 10 working days after receipt of the bar chart diagram, shall meet with a representative of the CONTRACTOR to review the proposed plan and schedule.

C. **Review Period:** Within five working days after the conclusion of the ENGINEER's review period, the CONTRACTOR shall revise the bar chart diagram as required and re-submit the diagram.

D. **Acceptance:** When the initial construction schedule has been accepted, the CONTRACTOR shall submit to the ENGINEER four copies of the accepted schedule.

E. **Construction Schedule Revisions:** The ENGINEER may require the CONTRACTOR to modify any portions of the bar chart schedule that become infeasible because of "activities behind schedule" or for any other valid reason. An activity that cannot be completed by its original latest completion date shall be deemed to be behind schedule. Failure to submit a revised project schedule where so requested by the ENGINEER shall be cause for withholding a requested progress payment.

F. **Revision Due to Change Order:** Upon approval of a change order, the approved change shall be reflected in the next bar chart submittal by the CONTRACTOR.

1.3 SCHEDULE OF VALUES

A. Schedule of values shall be submitted as specified in Section 01 29 00 "Measurement and Payment".

1.4 CONTRACTOR'S DAILY REPORTS

A. The CONTRACTOR shall complete a daily report on forms furnished by the ENGINEER indicating manpower, equipment, and subcontractors involved in the performance of the work.

B. CONTRACTOR shall submit copies of daily report forms to the ENGINEER monthly.

1.5 MONTHLY PROJECT STATUS REPORT

A. The CONTRACTOR shall submit, within two working days before the Construction Progress Meeting, a brief written Monthly Project Status Report.

B. The Monthly Project Status Report shall discuss the status of the project in relation to the construction progress schedule and identify issues to be discussed at the Monthly Construction Progress Meeting.

1.6 SHOP DRAWINGS

A. The CONTRACTOR shall submit, within 10 days after the effective date of the agreement, a complete list of equipment and materials requiring shop drawing approval. The term "shop drawing" as used herein, shall be understood to include detailed design calculations, fabrication and installation drawings, erection drawings, lists, graphs, operating instructions, catalog sheets, data sheets, and similar items. Unless otherwise required, said drawings shall be submitted at a time sufficiently early to allow review of same by the ENGINEER and to accommodate the rate of construction progress required under the contract. The shop drawing list shall contain an estimated submittal date for each piece of equipment. The ENGINEER shall return prints of each shop drawing with his comments within 30 calendar days after receipt of shop drawings from the CONTRACTOR. If the CONTRACTOR and OWNER determine that a speedy review of a submittal is critical to the progress of the project, then he should notify the ENGINEER at least 15 days in advance and request a speedy review of the submittal. The ENGINEER will return the submittal within 15 days of such critical submittals. If the review by the ENGINEER is delayed beyond a reasonable period, usually 60 days, then the CONTRACTOR shall notify the ENGINEER in writing that unless the said shop drawing is returned to the contractor within three (3) business days or there may be a delay CONTRACTOR's construction schedule.

B. The CONTRACTOR shall review all the submittals before forwarding them to the ENGINEER for review. The submittals shall be in conformance with the CONTRACT DOCUMENTS, and any minor variations shall be noted in the transmittal form. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal by the second submission of drawings. The OWNER reserves the right to withhold money due to the CONTRACTOR to cover additional costs of the ENGINEER's review beyond the second submission. All submittals shall be submitted electronically via email, file sharing link, or an approved construction document management program, such as Submittal Exchange or Procore, if required, as a searchable pdf document. The CONTRACTOR shall make any corrections required by the ENGINEER. All shop drawings shall be submitted through the GENERAL CONTRACTOR and be accompanied by the ENGINEER's standard shop drawing transmittal form. All resubmittals shall include one copy of the previously rejected submittal.

C. All shop drawings shall be submitted electronically utilizing an approved construction document management program, such as Submittal Exchange or Procore, as follows:

1. ELECTRONIC SUBMITTAL PROCEDURES

(a) Summary:

(1) Shop drawing and product data submittals shall be transmitted to Engineer in electronic (PDF) format, using a website service designed specifically for transmitting submittals between construction team members.

(2) The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.

(3) The electronic submittal process is not intended for color samples, color charts, or physical material samples

(b) Procedures:

(1) Submittal Preparation – The contractor may use any or all of the following options:

a. Subcontractors and Suppliers provide electronic (PDF) submittals to the Contractor via the construction document management website.

b. Subcontractors and Suppliers provide paper submittals to General Contractor, who electronically scans and converts them to PDF format.

c. Subcontractors and Suppliers provide paper submittals to Scanning Service, which electronically scans and converts to PDF format.

(2) Contractor shall review and apply an electronic stamp certifying that the submittal complies with the requirements of the Contract Documents, including verification of manufacturer/product, dimensions, and coordination of information with other parts of the work.

(3) Contractor shall transmit each submittal to Engineer using the construction document management website.

(4) Engineer review comments will be made available on the construction document management website for downloading. The contractor will receive email notifications of the completed review.

(5) Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.

(6) Contractor shall submit three paper copies of reviewed submittals upon approval of shop drawings to Engineer.

(c) Costs:

(1) General Contractor shall include the full cost of the construction document management project subscription in their Lump Sum Base Bid. This cost shall be included in the contract amount.

(2) Internet Service and Equipment Requirements:

a. Email address and Internet access at the Contractor's main office.

b. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

(d) Timeline and Closeout

(1) The construction document management project subscription shall be maintained and active until the warranty period is complete.

(2) CONTRACTOR shall verify all files have been transferred by the construction document management website to the ENGINEER and CONTRACTOR prior to closeout.

D. Revisions indicated on shop drawings shall be considered as changes necessary to meet the requirements of the Contract Drawings and Specifications and shall not be taken as the basis of claims for extra work. The CONTRACTOR shall have no claim for damages or extension of time due to any delay resulting from the CONTRACTOR's having to make the required revisions to shop drawings. The review of said drawings by the ENGINEER will be limited to checking for general agreement with the specifications and drawings and shall in no way relieve the CONTRACTOR of responsibility for errors or omissions contained therein, nor shall such review operate to waive or modify any provision contained in the Specifications or Contract Drawings. Fabricating dimensions, quantities of material, applicable code requirements, and other contract requirements shall be the CONTRACTOR's

responsibility. The ENGINEER will not be responsible for any delays arising from the equipment supplier's delay in making the changes requested to meet the specifications.

E. Each submittal shall contain data representing only one specification Section.

1.7 SAMPLES

A. Unless otherwise specified, whenever in the Specifications samples are required, the CONTRACTOR shall submit not less than two samples of each such item or material to the ENGINEER for approval at no additional cost to the OWNER.

B. Samples, as required herein, shall be submitted for approval a minimum of 21 days prior to ordering such material for delivery to the job site and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the work.

C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submittal to the ENGINEER for approval. Upon receiving approval from the ENGINEER, one set of the samples will be stamped and dated by the ENGINEER and returned to the CONTRACTOR. One set will be retained by the ENGINEER until the completion of the work.

D. Unless otherwise specified, all colors and textures of specified items will be selected by the ENGINEER from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.8 MAINTENANCE MANUALS

A. The CONTRACTOR shall submit to the ENGINEER three (3) copies of the manufacturer's maintenance manuals for all mechanical, electrical, and instrumentation equipment provided under this contract.

B. All maintenance manuals shall be submitted together with a copy of approved shop drawings for the respective item of equipment. Maintenance manuals shall be submitted prior to the 75 percent project completion stage.

C. The maintenance manuals shall be complete with recommended maintenance procedures, recommended spare parts, and complete assembly and disassembly instructions.

D. Operation and maintenance instructions shall include, as a minimum, the following data for each item of mechanical, electrical, and instrumentation equipment:

1. An itemized list of all data provided.
2. Name and location of the manufacturer, the manufacturer's local representative, the nearest supplier, and spare parts warehouse.
3. Approved submittal information applicable to operation and maintenance.
4. Recommended installation, adjustment, start-up, calibration, and troubleshooting procedures.
5. Tabulation of proper setting for all pressure relief valves (low/high), pressure switches, and other related equipment protection devices.
6. Recommended lubrication, including lubricant SAE grade, frequency of required lubrication, and an estimate of yearly quantity needed.
7. Recommended step-by-step procedures for all modes of operation.
8. Complete internal and connection wiring diagrams, including a list of all electrical relay settings.
9. Recommended preventive maintenance procedures and schedule.

10. Complete parts lists, by generic title and identification number, with exploded views of each assembly.
11. Recommended spare parts.
12. Disassembly, overhaul, and reassembly instructions.

E. The CONTRACTOR shall furnish four (4) complete sets of maintenance manuals bound in black expandable three post binders. Each set shall include a table of contents and a quick reference list of local manufacturer's representatives.

1.9 RECORD DRAWINGS

A. The CONTRACTOR shall maintain at the construction site one complete set of drawings suitably marked to show all deviations from the original set of drawings and other information as specified. Supplementary sketches shall be included, if necessary, to clearly indicate all work as constructed.

B. All work shall be clearly shown, and the record drawings shall be satisfactory to the OWNER in order to ensure that adequate information is indicated to show the actual construction. The complete set of the record drawings shall be submitted to the ENGINEER prior to the submittal of the final Application for Payment. Failure of the CONTRACTOR to maintain an up-to-date set of record drawings on the project site shall be a reason to withhold payments. All underground lines shall be determined from the record drawings.

1.10 SAFETY DATA SHEETS

A. The Contractor shall submit two copies of Safety Data Sheets (SDS) for each material on-site to the OWNER.

B. The Contractor shall maintain an orderly file of Safety Data Sheets (SDS) at the job site.

1.11 START-UP REPORTS

A. The CONTRACTOR shall submit copies of all equipment testing and start-up reports for process equipment, motors, HVAC equipment, electrical, generators, etc., as required.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 35 00 – CULTURAL RESOURCES PROTECTION

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and PRM 75 27, which provides for the preservation of potential historical, architectural, archaeological, or cultural resources (hereinafter called "cultural resources").

B. The Contractor shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources and fair compensation to the Contractor for delays resulting from such cultural resources investigations.

1.2 STOP WORK PROCEDURES

A. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The Engineer will issue a Stop Work order directing the Contractor to cease all construction operations at the location of such potential cultural resources.

2. Such Stop Work Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the State Archaeologist. Any Stop Work Order shall contain the following:

(a) A clear description of the work to be suspended.

(b) Any instructions regarding the issuance of further orders by the Contractor for material services.

(c) Guidance as to the action to be taken on subcontracts.

(d) Any suggestions to the Contractor on how to minimize his costs.

B. Estimated duration of the temporary suspension.

1. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the State Archaeologist, the Engineer will extend the duration of the Stop Work Order in writing, and the Contractor shall suspend work at the location of the find. An equitable adjustment of the construction contract time will be made.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 41 00 - REGULATORY REQUIREMENTS

PART 1 -- GENERAL

1.1 SUMMARY

A. Applicable codes and standards referred to in these specifications shall establish minimum requirements for equipment, materials, and construction and shall be superseded by more stringent requirements of drawings and specifications when and where they occur.

B. All equipment furnished and installed under the contract shall be designed, fabricated, assembled, installed, and placed into service. The equipment will conform to the applicable provisions of the Federal and State Safety and Health Standards, including but not limited to Federal Occupational Safety and Health Regulations for Construction; the Division of Environmental Health, Minnesota Department of Health; the Minnesota Pollution Control Agency; the Department of Natural Resources; the Minnesota Department of Transportation, Division of Highways; the Minnesota Industrial Commission and ordinances of the City that apply to this work.

C. All construction methods and tools shall comply with commonly accepted standards for safety and health of personnel engaged in construction, including but not limited to Federal Occupational Safety and Health Regulations for Construction; the Division of Environmental Health, Minnesota Department of Health; the Minnesota Pollution Control Agency; the Department of Natural Resources; the Minnesota Department of Transportation, Division of Highways; the Minnesota Industrial Commission and ordinances of the City that apply to this work.

D. Any conflicts between specifications and applicable codes and standards shall be referred to the Engineer.

1.2 PERMITS OBTAINED BY OWNER

A. The Owner has applied for the following permits from appropriate authorities. It is anticipated that permission to proceed will be authorized prior to the execution of the Contract. The Contractor shall perform all work and conduct itself in full accordance with the requirements of the applicable permit:

1. Minnesota Pollution Control Agency (MPCA) –Wastewater Treatment Plant Construction

2. Minnesota Pollution Control Agency (MPCA) - General Storm Water Permit - The Contractor and Owner shall jointly apply for this permit once the contract is awarded.

B. Contractor shall be responsible for posting any bonds, which may be required as a condition to any permit, and for securing and paying the cost of any other permits not mentioned above, which may be required.

1.3 PERMITS OBTAINED BY THE CONTRACTOR

A. The Contractor shall secure and pay the cost of these, and any other permits not mentioned, which may be required, including, but not limited to:

1. City Building Permit (paid through designated allowance specified in Section 01 21 00 - Allowances)

2. Storm Water Pollution Prevention Permit

3. Department of Natural Resources (DNR) Dewatering Permit

4. Work within City right-of-way permit.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

****END OF SECTION****

SECTION 01 42 00 - REFERENCES

PART 1 -- GENERAL

1.1 GENERAL

A. Applicable codes and standards referred to in these specifications shall establish minimum requirements for equipment, materials, and construction, and shall be superseded by more stringent requirements of drawings and specifications when and where they occur.

B. Reference to standard specifications of any technical society, organization, or association, or to codes of local or state authorities, shall mean the latest standard, code, specification, or tentative specification adopted and published at the date of taking bids unless specifically stated otherwise.

C. All equipment furnished and installed under the contract shall be so designed, fabricated, assembled, installed, and placed into service that such equipment will conform to the applicable provisions of the Federal and State Safety and Health Standards.

D. All construction methods and tools shall conform to the applicable provisions of the Federal and State Safety and Health Standards, and shall comply with commonly accepted standards for the safety and health of personnel engaged in construction work.

E. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor. The CONTRACTOR shall bid the most stringent requirements.

1.2 TRADE NAMES AND ALTERNATIVES

A. For convenience in designation in the Contract Documents, materials to be incorporated in the WORK may be designated under a tradename or the name of a manufacturer and its catalog information. The use of alternative material which is equal in quality and of the required characteristics for the purpose intended will be permitted, subject to the following requirements:

1. The burden of proof as to the quality and suitability of such alternative equipment products, or other materials shall be upon the CONTRACTOR.

2. The ENGINEER will be the sole judge as to the comparative quality and suitability of such alternative equipment, products, or other materials and its decision shall be final.

B. Wherever in the Contract Documents the name or the name and address of a manufacturer or distributor is given for a product or other material, or if any other source of a product or material is indicated, such information is given for the convenience of the CONTRACTOR only, and no limit, restriction, or direction is indicated or intended thereby, nor is the accuracy or reliability of such information guaranteed. It shall be the responsibility of the CONTRACTOR to determine the accuracy of the information and to identify and locate any such manufacturer, distributor, or other sources of any product or material called for in the Contract Documents.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

****** END OF SECTION ******

SECTION 01 42 13 - ABBREVIATIONS

PART 1 -- GENERAL

1.1 GENERAL

A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these specifications, the following acronyms or abbreviations which may appear in these specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS AND ACRONYMS

10SS	Recommended Standards for Water Works, 2012 Edition (commonly known as Ten States Standards)
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of the State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AIS	American Iron and Steel
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BABA	Build American Buy American
BBC	Basic Building Code, Building Officials, and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CBM	Certified Ballast Manufacturers
CEAM	City Engineer's Association of Minnesota
CGA	Compressed Gas Association

CLFMI	Chain Link Fence Manufacturers Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcement and Steel Institute
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
IBC	International Building Code, International Conference of Building Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	Insurance Services Office
MBMA	Metal Building Manufacturer's Association
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MPTA	Mechanical Power Transmission of Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NGLI	National Lubricating Grease Institute
OSHA	Occupational Safety and Health Act of 1970
PCA	Portland Cement Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SMA	Screen Manufacturer's Association
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
UL	Underwriters' Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

****** END OF SECTION ******

SECTION 01 45 00 - TESTS AND INSPECTIONS

PART 1 -- GENERAL

1.1 SCOPE OF TESTS

A. All materials, equipment, installation, and workmanship included in this contract, if so required by the ENGINEER, shall be tested and inspected to prove compliance with the contract requirements.

B. No tests specified herein shall be applied until the item to be tested has been inspected and approval given for the application of such test.

C. Tests and inspections shall include:

1. The delivery acceptance tests and inspections.
2. The installed tests and inspections of items as installed.
3. Performance guarantee tests.
4. Final testing and start-up.

D. Tests and inspections, unless otherwise specified or accepted, shall be in accordance with the recognized standards of the industry.

E. The CONTRACTOR shall pay for tests and inspections normally conducted by manufacturers and material suppliers and for any other tests and inspections, which may be so specified herein. The OWNER shall pay the cost of testing and inspection not normally conducted by manufacturers or material suppliers or not specified herein.

F. CONTRACTOR shall conduct field tests on his work as required to comply with applicable codes, to determine acceptability of workmanship, and as specified including but not limited to the following:

1. Hydrostatic tests of piping, equipment, and water retaining structures.
2. Tests of welded joints as specified.
3. Leakage tests on steel tanks assembled by CONTRACTOR and hydraulic structures.
4. Calibration tests.
5. Simulation tests on control systems.
6. Preliminary tests and checks associated with placing equipment and systems into service.
7. Thickness and holiday tests on painting.
8. Other tests as defined in the specifications.

1.2 EVIDENCE OF TEST

A. The form of evidence of satisfactory fulfillment of delivery acceptance test and of installed test and inspection requirements shall be, at the discretion of the ENGINEER, either by tests and inspections carried out in his presence or by certificates or reports of tests and inspections carried out by approved persons or organizations.

1.3 DELIVERY ACCEPTANCE TESTS

A. The delivery acceptance tests and inspections shall be at the CONTRACTOR's expense for any materials or equipment specified herein and shall include the following:

1. Test of items during the process of manufacture and/or on completion of manufacture, comprising material tests, hydraulic pressure tests, electric tests, performance and operating tests, and inspections in accordance with the relevant standards of the industry and, more particularly, as detailed in individual clauses of these specifications or as may be required by the ENGINEER to satisfy himself that the items tested and inspected comply with the requirements of this contract.

2. Inspection of all items delivered at the site in order that the ENGINEER may be satisfied that such items are of the specified quality and workmanship and are in good order and condition at the time of delivery.

1.4 INSTALLED TESTS AND INSPECTIONS OF ITEMS AS INSTALLED

A. All mechanical and electrical equipment shall be tested by the CONTRACTOR to the satisfaction of the ENGINEER before any facility is put into operation. Tests shall be as specified herein and shall be made to determine whether the equipment has been properly assembled, aligned, adjusted, and connected. Any changes, adjustments, or replacements required to make the equipment operate as specified shall be carried out by the CONTRACTOR as part of the work.

1.5 PERFORMANCE GUARANTEE TEST

A. Where performance guarantee tests are required, the CONTRACTOR shall conduct the test as specified in the presence of the ENGINEER.

1.6 FINAL TESTING AND START-UP

A. At least 60 days before the time allowed in his construction schedule for commencing testing and start-up procedures, the CONTRACTOR shall submit to the ENGINEER, in duplicate, details of the procedures he proposed to adopt for testing and start-up of all mechanical and electrical equipment to be operated singly and together, excepting when such procedures have been covered in the specifications. Tests of pumps or other equipment requiring water for operation shall be conducted using clear water. The water required for such tests shall be provided by the CONTRACTOR.

B. During the testing of mechanical, instrumentation, and electrical equipment, the CONTRACTOR shall make available experienced factory-trained representatives of the manufacturers of all the various pieces of equipment, who shall instruct the OWNER's personnel in the operation and care thereof. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment.

C. After successful testing, the manufacturer's representatives shall provide the CONTRACTOR with an affidavit that the equipment installation is complete and has been carried out in full conformance with the manufacturer's recommendations. The CONTRACTOR shall forward to the ENGINEER copies of each affidavit received prior to final payment.

D. If, under test, any portion of the work fails to fulfill the contract requirements and is altered, renewed, or replaced, tests on that portion so altered, removed, replaced, together with all other portions of the work as are affected thereby, shall, if so required by the ENGINEER, be repeated within a reasonable time and in accordance with the specified conditions, and the CONTRACTOR shall pay to the OWNER all reasonable expenses incurred by the OWNER as a result of the carrying out of such tests.

E. Before final acceptance of the work, the CONTRACTOR shall return any units, which have been put in temporary storage to an operating condition. He shall demonstrate that all components of the mechanical systems are properly functioning and in a fully operational condition. All pumps, motors, and related equipment shall be operated during the trial period. A range of discharge head conditions shall be affected for pumping units by partially closing valves as directed by the ENGINEER. In the event malfunctions are discovered, the CONTRACTOR shall correct them. If necessary, manufacturer's representatives shall be recalled to make corrections or adjustments.

F. Final testing and start-up shall be combined with the instruction of operating personnel to the end that when final testing is completed, the stations can be turned over to the OWNER in an operating condition, and the district personnel will be prepared to continue the operation in an orderly manner. Instruction of operating personnel by manufacturer's representatives shall be performed during this period.

1.7 REPEAT TESTS

A. Where, in the case of an otherwise satisfactorily installed test, any doubt, dispute, or difference should arise between the ENGINEER and the CONTRACTOR regarding the test results or the methods or equipment used in the carrying out by the CONTRACTOR of such test, then the ENGINEER may order the test to be repeated. If the repeat test, using such modified methods or equipment as the ENGINEER may require, substantially confirms the previous test, then all costs in connection with the repeat test will be paid by the OWNER; otherwise, the costs shall be borne by the CONTRACTOR. Where the results of any installed test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by the CONTRACTOR at his own expense.

1.8 TESTING AND LABORATORY SERVICES

A. **Independent Testing Laboratory:** Where tests or inspections by an independent testing laboratory are required by this specification, the CONTRACTOR shall employ and arrange for, at his expense, the services of an approved independent testing laboratory satisfactory to the ENGINEER to perform the testing utilizing recognized standard procedures and criteria.

B. **Reports and Certificates:** The CONTRACTOR shall submit reports and certificates of all inspections and tests to the ENGINEER in duplicate. The reports and certificates become the property of the OWNER.

C. **Sample Materials:** The CONTRACTOR shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by them.

D. **Additional Tests:** Any additional tests required beyond those required under this specification may be ordered by the ENGINEER to settle disagreements with the CONTRACTOR regarding the quality of work done. If the work is defective, the CONTRACTOR shall pay all costs of the extra tests and shall correct the work. If the work is satisfactory, the OWNER will pay for extra tests.

1.9 ENGINEER'S REPRESENTATIVE AND INDEPENDENT LABORATORY TESTING

A. The ENGINEER will provide a full-time Resident Project Representative (RPR) to ascertain that the work is generally accomplished properly and in accordance with the plans and specifications. Whether in the field or in the CONTRACTOR's shop or shops of his subcontractors, the RPR shall have full access to the work and shall be given full cooperation. The RPR shall have the authority, subject to the final decision of the ENGINEER, to reject any defective work or material or to suspend the work if

not being properly performed. The RPR shall have no authority to permit any deviation from the plans and specifications except on written order from the ENGINEER.

B. The OWNER will retain and compensate a qualified testing laboratory to provide testing of concrete, earthwork, roadway surfacing, and similar items of work. Field tests and job samples shall be made by the CONTRACTOR at the option of the ENGINEER to ensure proper control of materials and installation of materials under this Contract.

1.10 LEAKAGE TESTING AND DISINFECTION

A. General

1. Except as otherwise provided herein, the CONTRACTOR shall furnish all equipment, labor, and materials required for testing hydraulic structures and pipelines as specified. Water for testing and disinfecting will be furnished by the OWNER; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the OWNER-designated source to the points of use.

2. All hydraulic structures and pressure pipelines shall be tested; however, disinfection shall be limited to pipelines, tanks, and structures designed for potable water service. Disinfection shall be accomplished by chlorination. Chlorine dosages will be computed by the ENGINEER, who will furnish the CONTRACTOR with instructions for the proper application of chlorine. All chlorinating and testing operations shall be done in the presence of the ENGINEER.

3. Release of water from structures and pipelines, after testing has been completed, shall be as directed by the ENGINEER.

4. Prior to testing, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high-pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm; all pipelines shall be thoroughly flushed or blown out, as appropriate.

B. Testing of Hydraulic Structures

1. Testing shall be performed prior to backfilling, except where otherwise permitted by the ENGINEER. Testing shall not be performed sooner than 14 days after all portions of structure walls have been completed. The test shall consist of filling the structure with water to the maximum operating water surface. The rate of filling shall not exceed 24 inches of depth per day. After testing has been completed, water shall be disposed of as directed by the ENGINEER.

2. If the structure does not require backfilling around it, then the structure could be filled with water at a rate chosen by the CONTRACTOR provided the concrete has reached its design strength.

3. After the structure has been filled as specified, the leakage test shall be performed as follows: An initial water level reading shall be made. Seven days following the initial reading, a second reading shall be made. The structure shall be considered to have passed the test if water loss during the 7-day period, as computed from the 2 water level readings, does not exceed 1/20 of 1 percent of the total volume (0.0005 x Tank Volume) after allowance is made for evaporation loss. Visible leaks or seepage shall be fixed regardless of the leakage test results. Should the structure fail to pass the test, the test shall be repeated for up to 3 additional 7-day test periods. If at the end of 28 days the structure still fails to pass the leakage test, the CONTRACTOR shall empty the structure as directed by the ENGINEER and shall examine the interior for evidence of any cracking or other conditions that might be responsible for the leakage. Any cracks shall be “vee’ d” and sealed with sealant. Regardless of the leakage test results, any evidence of leakage or seepage through the cracks and joints shall be repaired to the satisfaction of the ENGINEER. Seepage through the cracks may be sealed using Zypex or Kryton products. Following these

operations, the CONTRACTOR shall again test the hydraulic structure. In the case of a clearwell or reservoir, the retesting shall again be combined with disinfection, exclusive of the spraying operation.

C. Disinfection of Hydraulic Structures and Appurtenant Pipelines

1. All hydraulic structures, which store or convey potable water, shall be disinfected by chlorination. Chlorination of hydraulic structures shall be performed in accordance with the requirements of AWWA C652 using Method 1, 2, or 3 or a combination of methods, except that filter basins shall be disinfected in accordance with AWWA C653.

D. Hydrostatic Testing of Pipelines

1. Process piping may be field-tested for leakage at 100 psi in accordance with the appropriate section (hydrostatic tests) of AWWA C600-2017. Test pressure and duration shall be per AWWA C600-2017, and allowable leakage shall be determined in accordance with the formula:

$$L = \frac{S*D*\sqrt{P}}{148{,}000}$$

where factors and units are defined as follows: L=Leakage, S=Length (ft.), D = Nominal Diameter (in.), and P = Average Test Pressure (PSI).

CONTRACTOR shall conduct tests under the supervision of the ENGINEER.

Line	Test Pressure*
Forcemains and Watermains	150 psi
Two-Inch Water Service	150 psi
Gravity Full Flow Process Piping	50 psi

* Test pressure based on the elevation of the lowest point in the line under test and corrected to the elevation of the test gauge.

E. Testing Gravity Pipelines and Sewer Mains

1. Hydrostatic Test Procedure

(a) The test section shall be bulkheaded and the pipe subjected to a hydrostatic pressure produced by a head of water at a depth of three (3) feet above the top of the pipe or sewer at the upper structure or manhole under test. In areas where the groundwater exists, this head shall be 3 feet above the existing water table.

(b) This head of water shall be maintained for a period of one (1) hour for the pipe body to absorb water completely and thereafter for a further period of one (1) hour for the leakage test. During this one-hour test period, the measured maximum allowable rate of exfiltration shall not exceed 100 gallons per inch diameter per mile of pipe per 24 hours.

Sewer Diameter (inches)	Max. Allowable Loss (Gal/hr 100 ft.)
6	0.5
8	0.6
10	0.8
12	1.0
15	1.2
18	1.4
21	1.7
24 & larger	1.9

2. Air Test Procedure

   (a) If the CONTRACTOR elects to air test, he shall perform these tests with equipment similar to Air-Loc equipment manufactured by Cherne Industrial Inc., Hopkins, Minnesota.

   (b) The air test shall be made on a clean pipe. The line shall be plugged at each end with pneumatic balls. Low-pressure air shall be introduced into the line to pressurize the line 4 psi above the average back pressure on the pipe due to submergence in groundwater. Allow at least two (2) minutes for the air temperature to stabilize and then start timing and the pressure readings.

   (c) The portion of the line being tested shall not lose air at a rate to cause the pressure to drop from 3.6 psi to 3.0 psi in less time than listed below:

Pipe Diameter (in.)	Minimum Allowable Time (minutes)
4	2.0
6	3.0
8	4.0
10	5.0
12	6.0
14	7.0
15	7.0
18	8.5
20/21	10.0

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 50 00 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 -- GENERAL

1.1 WORK INCLUDED

A. ENGINEER's Field Office

B. CONTRACTOR's Field Office

C. Electricity and Lighting

D. Potable Water

E. Temporary Heating

F. Sanitary Facilities

G. Temporary Bracing

H. Enclosures

I. Water Control

J. Cleaning During Construction

K. Removal

1.2 ENGINEER'S FIELD OFFICE

A. The CONTRACTOR shall provide the OWNER's resident ENGINEER with a temporary mobile office-type trailer. Two sets of keys shall be given to the ENGINEER for locks on the office door. The ENGINEER's field office shall have a floor area of at least 200 square feet and shall be provided with the following:

1. **Heater:** Thermostatically controlled furnace (oil or gas) capable of heating the office to 70°F when the outside temperature is 20°F below zero.
2. **Lighting:** Dual 48-inch fluorescent lighting fixture over each working area.
3. **Convenience Outlets:** Provide as required.
4. **Desk:** 30 inches wide x 50 inches long, with a chair.
5. **Chair:** Provide two additional chairs.
6. **File:** One metal four-drawer legal size filing cabinet.
7. **Storage Shelves:** Four 48 inches x 12 inches.
8. **Air Conditioner:** Thermostatically controlled electric air conditioner capable of maintaining an office temperature of 80° F or less when the outside temperature is 100° F.
9. **Water Supply:** Provide potable bottled drinking water cooler and potable water.
10. **Entrance Platform:** Provide a 3-foot wide x 4-foot long platform with a handrail and required steps at the door of the trailer.

B. The general arrangement of the office and the facilities provided shall be acceptable to the ENGINEER.

C. The CONTRACTOR shall bear the costs of all utility bills until the facility is turned over to the OWNER. The CONTRACTOR shall bear all costs of utility installation, including telephone installation and the fixed monthly charges for the telephones. If a telephone is provided for the exclusive use of the ENGINEER, then only the toll charges will be paid by the ENGINEER. The Contractor shall submit an invoice for the toll charges on a monthly basis. All facilities and equipment provided under this section shall remain the property of the CONTRACTOR. Upon completion of the project, or as directed by the ENGINEER, the CONTRACTOR shall remove the temporary structure from the site, and leave the premises in the condition required by the contract.

1.3 CONTRACTOR'S OFFICE AT SITE OF WORK

A. The CONTRACTOR shall maintain a substantial watertight building at or near the site of work which shall be the headquarters of his representative authorized to receive drawings, instructions, or other communications or articles. Any communication given to the said representative or delivered at the CONTRACTOR's office at the site of work shall be deemed to have been delivered to the CONTRACTOR.

B. Copies of drawings, specifications and other contract documents shall be kept at the CONTRACTOR's office at the site of work and available for use at all times.

1.4 ELECTRICITY AND LIGHTING

A. The CONTRACTOR shall furnish, install and maintain a construction light and power system for use during construction. The CONTRACTOR shall pay the costs of electrical energy necessary for the work of the project.

B. As soon as possible after the commencement of the work, the CONTRACTOR shall arrange for the temporary service with the power company. The CONTRACTOR shall furnish and install a weatherhead, meter socket, and all feeders and panels required from this point and shall pay for all power company service fees. The service made available by the power company will be 200 amp, 120/240 volts, single phase, and 3-wire. Coordinate the location of the pole with the CONTRACTOR and utility. The CONTRACTOR shall pay the costs of any permits, connect/disconnect charges, and meter deposits.

C. The CONTRACTOR shall install a temporary power panel and a minimum of four 20 amp, 120 volt, weatherproof, GFI grounding, and duplex receptacles at or near the pole. Each outlet shall be circuited separately.

D. As soon as conditions permit, the CONTRACTOR shall extend the temporary service to the new buildings and install a temporary distribution system and temporary power and lighting branch circuits within the buildings.

E. Temporary lighting shall consist of at least one 200-watt incandescent lamp, or equivalent lighting for every 625 square feet of floor area with at least one light in each room. Provide additional lights in stairwells as necessary to provide adequate illumination. The CONTRACTOR shall furnish all light bulbs for the temporary lighting system.

F. The CONTRACTOR shall provide at least one 20 amp, 120 volts, temporary branch circuit with three grounding, duplex receptacles for every 1,000 square feet of floor area. Receptacles shall be located so that extension cords will not exceed 100 feet in length. The temporary branch circuits may be used

for portable tools, portable lights, and other small power loads. Each contractor shall furnish his own extension cords, and contractors requiring supplemental lights shall furnish their own portable lights.

G. The temporary light and power system shall not be used for electric heating, electric welders, or other loads exceeding 1.5 KVA at 120 volts or 3.0 KVA at 250 volts. If any contractor requires power for tools larger than these maximum loads, he shall make arrangements for a separate temporary service and distribution system and pay the energy and other costs thereof.

H. The CONTRACTOR shall remove the temporary light and power system when no longer required.

I. The CONTRACTOR shall make arrangements and pay the costs for electrical service, lighting, and power for his field office, storage sheds, and other temporary buildings.

J. When the installation of the permanent electrical service and distribution system is sufficiently complete to be operated safely, the system may be used to provide construction light and power and testing and operation of permanent equipment.

K. The OWNER will assume the responsibility and pay the costs of providing electrical light and power, including the energy costs on the date of his occupancy or the Date of Substantial Completion, whichever is sooner.

1.5 POTABLE WATER

A. The CONTRACTOR may purchase potable water from the OWNER. However, the CONTRACTOR shall provide the facilities necessary to convey water (meter, backflow preventer, pipe, etc.) from the OWNER-designated source to the points of use. The location of the water source shall be as shown in the drawings or as dictated by the OWNER. This potable water may be used for construction uses such as hydrostatic tests. The CONTRACTOR shall notify the OWNER before utilizing the potable water for construction uses and shall cooperate with the OWNER in scheduling any large water demands so as to minimize the disruptions to the OWNER's water distribution system.

1.6 TEMPORARY HEATING

A. At the "Temporary Enclosure" stage, the CONTRACTOR shall provide and pay costs of heat, fuel, and services necessary to perform and protect his work.

B. Such temporary heat shall be provided as required to:

1. Facilitate progress of work.
2. Protect work and products against dampness and cold.
3. Provide suitable ambient temperature and humidity levels for installation and/or curing of materials.
4. Provide ventilation to meet health regulations for a safe working environment.
5. Allow beneficial occupancy of the project, or portion thereof, prior to final completion.

C. Temperature Required

1. Generally, 24 hours daily, maintain a minimum of 40° F (4.5° C).
2. Twenty-four hours daily during concrete placement and 7 days thereafter, minimum 45° F (7.5° C).
3. Twenty-four hours daily, 7 days prior to, and during placing of interior finishes, and 24 hours daily thereafter until substantial completion: 68°F (20°C) minimum.

D. Ventilation required: 80°F (27° C) maximum.

1. Prevent hazardous accumulations of dust, fumes, mists, vapors, or gases in all areas during construction.

2. Provide adequate ventilation for curing installed materials.

E. Heating shall be provided by the permanent heating system (to the extent reasonably possible) or by such temporary units, piping, etc., necessary to maintain the above temperatures.

1.7 SANITARY FACILITIES

A. The CONTRACTOR shall make arrangements for use of adequate toilet facilities at or near the site of work. Such facilities shall be subject to the acceptance of the ENGINEER as to location and type. The CONTRACTOR shall maintain the same in sanitary condition from the beginning of the work until completion and shall then remove the facilities and disinfect the premises. All portions of the work shall be maintained at all times in a neat, clean, and sanitary condition.

1.8 TEMPORARY BRACING

A. CONTRACTOR shall provide all temporary bracing necessary to hold frame or walls securely plumb and true until all permanent structural elements are in place and securely fastened. This includes temporary bracing of frame members as necessary to withstand wind loads. All bracing, sheeting, and shoring, used in the performance of the work shall be removed prior to backfilling of trenches unless otherwise directed by the ENGINEER.

1.9 ENCLOSURES

A. The CONTRACTOR shall be responsible for both temporary and permanent weather tightness of all walls and roofs. Temporary enclosures must be provided at all openings which might admit rain or snow. All work on roofs, after the roofs are installed, must be done over planking or other suitable protection.

1.10 WATER CONTROL

A. The site shall be graded to drain. Excavations shall be maintained free of water.

1.11 CLEANING DURING CONSTRUCTION

A. Waste material and other accumulated rubbish shall be disposed of daily.

1.12 REMOVAL

A. Remove temporary materials, equipment, services, and construction prior to substantial completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities. Grade site and restore existing facilities used during construction to specified or original condition.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 57 00 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 -- GENERAL

1.1 EXPLOSIVES AND BLASTING

A. The use of explosives will not be permitted.

1.2 DUST ABATEMENT

A. The CONTRACTOR shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent his operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in, or occupying buildings in, the vicinity. The CONTRACTOR shall be responsible for any damage resulting from any dust originating from his operations. The dust abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the ENGINEER. No separate payment will be allowed for dust abatement measures and all costs thereof shall be included in the CONTRACTOR's bid price.

1.3 RUBBISH CONTROL

A. During the progress of the work, the CONTRACTOR shall keep the site of the work and other areas used by the CONTRACTOR in a neat and clean condition, and free from any accumulation of rubbish. The CONTRACTOR shall dispose of all rubbish and waste materials of any nature occurring at the worksite, and shall establish regular intervals of collection and disposal of such materials and waste. He shall also keep his haul roads free from dirt, rubbish, and unnecessary obstructions resulting from his operations. Equipment and material storage shall be confined to areas approved by the ENGINEER. Disposal of all rubbish and surplus materials shall be done off-site of construction, at the CONTRACTOR's expense, all in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Subpart H, Section 1926.252 of the OSHA Safety and Health Standards for Construction.

1.4 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, a reactant, or of another classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.5 EROSION CONTROL

A. The CONTRACTOR shall comply with the MPCA's "General Storm Water Permit".

B. The CONTRACTOR shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent his operation from producing any soil erosion in amounts damaging to property or adjacent lands. The CONTRACTOR shall be responsible for any damage resulting from any soil erosion originating from his operations. Erosion abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the ENGINEER. No separate payment will be allowed for erosion abatement measures and all costs thereof shall be included in the CONTRACTOR's bid price.

C. Suggested erosion abatement measures are as follows:

1. Proper site grading and prompt turf re-establishment.
2. The use of bales on all excavated or non-re-established turf slopes.
3. Completion of all county ditch crossings during the workday.
4. Pave all disturbed streets as quickly as practical.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Minimize stripping vegetation or turf cover, and exposing the soils.

B. Provide and maintain storm sewer inlet protection at the project site and downgradient from the project.

C. Any excavations shall not be left open at night and shall require a chain-link fence around the pit or heavy steel plates over the pit.

D. Protect stockpiles from erosion.

E. Repair disturbed streets as quickly as possible.

**** END OF SECTION ****

SECTION 01 60 00 - MATERIALS, EQUIPMENT, LABOR, AND WORKMANSHIP

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. Products

B. Transportation and Handling

C. Storage and Protection

1.2 PRODUCTS

A. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor. The CONTRACTOR shall bid the most stringent requirements.

B. The naming of a manufacturer in this specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified. All exceptions to the specifications shall be indicated in the shop drawing.

C. Unless otherwise specified, all equipment and materials shall be new and of first-line quality. All workmanship shall be of first-line quality and free from defects.

D. All equipment and materials incorporated in the work shall be designed to meet the applicable safety standards of federal, state, and local laws, rules and regulations. All equipment requiring electrical power shall have an Underwriter Laboratories "UL" label. Equipment sent to the project site without the "UL" label will be rejected.

E. The CONTRACTOR shall, if required, furnish satisfactory evidence as to the source, kind, and quality of equipment and materials.

F. CONTRACTOR shall furnish, or require his subcontractors to furnish, proper tools and equipment and the services of all mechanics, laborers, and other employees necessary in the construction, testing, and execution of the work and the placing of all equipment in service.

G. All equipment and materials shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, or processor, except as otherwise provided in the Contract Documents.

1.3 TRADE NAMES AND ALTERNATIVES

A. For convenience in designation in the Contract Documents, materials to be incorporated in the WORK may be designated under a tradename or the name of a manufacturer and its catalog information. The use of alternative material which is equal in quality and of the required characteristics for the purpose intended will be permitted, subject to the following requirements:

1. The burden of proof as to the quality and suitability of such alternative equipment products, or other materials shall be upon the CONTRACTOR.

2. The ENGINEER will be the sole judge as to the comparative quality and suitability of such alternative equipment, products, or other materials and its decision shall be final.

B. Wherever in the Contract Documents the name or the name and address of a manufacturer or distributor is given for a product or other material, or if any other source of a product or material is indicated, such information is given for the convenience of the CONTRACTOR only, and no limit, restriction, or direction is indicated or intended thereby, nor is the accuracy or reliability of such information guaranteed. It shall be the responsibility of the CONTRACTOR to determine the accuracy of the information and to identify and locate any such manufacturer, distributor, or other sources of any product or material called for in the Contract Documents.

1.4 TRANSPORTATION AND HANDLING

A. All equipment shall be adequately and effectively protected against damage from moisture, dust, handling, or other cause during transport from the CONTRACTOR's premises to the site. Ponding of water shall not be permitted in the equipment storage area.

B. Prior to any equipment delivery, the CONTRACTOR shall attain the manufacturer's storage requirements for his equipment and forward one copy to the ENGINEER.

C. Each item or package shall be clearly marked with the appropriate number of this specification, and each separate portion of the plant shall receive, as far as practicable, a fitting or distinguishing mark which shall be shown on the packing lists. Each item of equipment shall have a firmly affixed label or tag with its equipment number or other discrete identifying marks.

D. The bearings of motors shall be relieved of load during transport by means of jacks or some other method to prevent "Brinelling."

E. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts or equipment may be delivered in assembled or sub-assembled units where possible.

1.5 STORAGE AND PROTECTION

A. Products shall be stored in accordance with the manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures that maintain the temperature and humidity recommended by the manufacturer.

B. Store loose granular materials on solid surfaces in well-drained areas; prevent mixing with foreign matter.

C. Arrange storage to provide access for inspection.

D. Prior to and after installation, all equipment shall be protected against weather, dust, moisture, and mechanical damage. During concrete operations, including finishing, all equipment that may be affected by cement dust must be completely covered. During painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint. Electrical switchgear, unit substation, and motor load centers shall not be installed until after the concrete work in those areas has been completed and accepted and the ventilation systems installed.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 01 77 00 - PROJECT CLOSEOUT

PART 1 -- GENERAL

1.1 CLEANUP

A. The CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish, and other debris resulting from the work, and at the completion of the work he shall remove all waste materials, rubbish, and debris from the premises as well as all tools, construction equipment, machinery, and surplus materials. He shall leave the site clean and ready for occupancy by the OWNER. Early acceptance of process equipment shall not waive clean-up prior to final acceptance.

B. The Contract shall provide cleaning of all surfaces, systems, and fixtures, including removal of labels, tags, grease, oil, dirt stains, etc.

C. This cleaning will include the removal of dust from walls and other vertical surfaces and ceilings, and washing of all glass and counter surfaces. It also will include cleaning and waxing or sealing all floors as specified for the individual floor material.

D. Upon acceptance of a building, the OWNER will assume the normal janitorial cleaning services. Re-cleaning of any soiled areas due to the CONTRACTOR's operation shall be the responsibility of the CONTRACTOR.

1.2 GUARANTEE

A. The CONTRACTOR shall guarantee all work and material against all defects for a period as specified in the General Conditions and or as modified by the Supplementary Conditions from the date of substantial completion. The CONTRACTOR shall repair or replace any such defective work and materials to conform to the provisions of the contract and without expense to the OWNER, within ten (10) days after notification in writing by the OWNER or ENGINEER of such defective work or material. The CONTRACTOR shall perform his work so as to cause the OWNER a minimum of inconvenience and interruption of services. If the CONTRACTOR has not done said repairs or replacements or made arrangements for the correction thereof within the period specified above, the OWNER may do so and charge the cost to the CONTRACTOR.

B. Guarantee on equipment placed into operation prior to substantial completion shall start from the date of substantial completion.

C. If the performance bond is posted, the performance bond will not be released until the guarantee period is over.

1.3 CORRECTION OF DEFECTIVE WORK DURING THE WARRANTY PERIOD

A. If during the warranty period, any work is found to be defective, the CONTRACTOR shall promptly, without cost to the OWNER and in accordance with the OWNER's written instructions, either correct such defective work, or if it has been rejected by the OWNER, remove it from the site and replace it with acceptable work.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as part of such required repair work.

C. If the CONTRACTOR does not promptly comply with the terms of such instructions, the OWNER may have the defective work corrected or the rejected work removed and replaced, and all direct and indirect costs of such correction or removal and replacement, including compensation for additional professional services, shall be paid by the CONTRACTOR.

D. The OWNER shall give notice of observed defects with reasonable promptness.

E. Under emergency conditions, the OWNER may remedy defective work without waiting for action by the CONTRACTOR. The OWNER will notify the CONTRACTOR immediately of the circumstances and actions taken, and the CONTRACTOR shall pay all reasonable substantiated costs of such actions.

1.4 FINAL INSPECTION

A. After the cleaning up of the work, premises, and all other areas and structures connected with the performance of the contract, the work as a whole shall be inspected by the ENGINEER and OWNER; and any workmanship or materials found not meeting the requirements of the specifications shall be removed by and at the expense of, the CONTRACTOR and good and satisfactory workmanship or material substituted, therefore. All settlement, defects, or damage to any part of the work shall be remedied and made good by the CONTRACTOR.

1.5 PROJECT ACCEPTANCE

A. The project shall be accepted after the final inspection has been conducted and all settlements, defects, damages, etc., discovered during the final inspection have been remedied.

1.6 FINAL SUBMITTALS

A. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER for transmittal to the OWNER:

1. Written guarantee, where required.
2. Copies of all equipment testing and start-up reports for process equipment, motors, HVAC equipment, electrical, generators, etc.
3. Operating manuals and instructions.
4. Keying schedule.
5. Maintenance stock items, spare parts, and special tools.
6. Completed record drawings.
7. Bonds for roofing, maintenance, etc., as required.
8. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
9. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provision of the law.

1.7 FINAL ESTIMATE AND PAYMENT

A. When the ENGINEER is of the opinion that the CONTRACTOR has completely performed all work required under the contract, he will submit to the CONTRACTOR a draft of the final estimate. The CONTRACTOR will be expected to submit his written approval of said final estimate within 5 calendar days after receipt, or in the event the CONTRACTOR disagrees with said final estimate, he shall within said 5 day period, file a written statement of all claims which he intends to present. If the

CONTRACTOR delays more than 5 calendar days in approving said final estimate or in presenting his own claims, the time for the final payment shall be extended by the period of such delay.

B. Upon receipt by the ENGINEER of the CONTRACTOR's written approval of said final estimate, the ENGINEER will certify physical completion of the work to the OWNER and will recommend acceptance of the work.

C. After acceptance of the work by the OWNER's governing body and 30 calendar days after the filing of the Notice of Completion, the OWNER will pay to the CONTRACTOR the amount remaining after deducting all prior payments and all amounts to be kept or retained under the provisions of the contract. In the event acceptance of the work is delayed more than 30 calendar days beyond the date of the last partial payment under the contract, the OWNER will make a further partial payment.

D. If the CONTRACTOR disagrees with the ENGINEER's final estimate and files a written statement of his claims in accordance with Subsection 01 77 00 1.7 A., the ENGINEER will issue as a semi-final estimate, the proposed estimate submitted to the CONTRACTOR, and the OWNER will make payment to the CONTRACTOR in accordance with the provisions of Subsection 01 77 00 1.7 C. The ENGINEER will then investigate the CONTRACTOR's claims, make any revisions to said semi-final estimate as he deems appropriate, and certify in writing to the OWNER the amount and value of the work performed by the CONTRACTOR. The OWNER will then make the final payment to the CONTRACTOR in accordance with the provisions of Subsection 01 77 00 1.7 C.

E. Final payment terminates liability of OWNER. The acceptance by the CONTRACTOR of the final payment shall be a release of the OWNER and its agents from all claims of any liability to the CONTRACTOR for anything done or furnished for, or relating to, the work or for any act or neglect of the OWNER or of any person relating to or affecting the work, except claims against the OWNER for the remainder, if any, of the amounts kept or retained. The CONTRACTOR shall certify that the provisions of Minnesota Statutes 290.92 have been complied with and that all claims against the CONTRACTOR by reason of the CONTRACT have been paid or satisfactorily secured.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 02 00 00 - GENERAL INFORMATION

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The Contractor shall furnish all labor, materials, tools, and equipment and perform all work and services necessary or incidental for site work and yard improvements in accordance with the requirements of the Contract Documents.

B. The site work includes but is not limited to, the following major items of work:

1. Site Preparation
2. Excavation, Backfill, and Grading
3. Fencing
4. Demolition of Existing Structures
5. Landscaping
6. Roadwork and Paving
7. Sidewalks
8. Utility Installation
9. Manhole Structures

1.2 SUMMARY OF WORK

A. The General Conditions, Supplementary Conditions, and Special Conditions of these Contract Documents apply to Division 02.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The State of Minnesota, Department of Highways, “Standard Specifications for Construction,” 2020 Edition and Current Supplemental Specifications for Construction Division II & III, shall govern. The numbers shown in parenthesis in the following Special Provisions refer to the section of the governing specifications.

B. “Standard Utilities Specifications for Watermain and Sanitary Sewer and Storm Sewer Installation,” as prepared and published by the City Engineers Association of Minnesota, dated 2018, shall apply to construction in this contract except as modified or altered in these Special Provisions and are referred to as CEAM Specifications.

PART 2 -- PRODUCTS

2.1 SHOP DRAWINGS

A. All submittals of Shop Drawings and Equipment Data shall be as specified in Section 01 33 00 “Submittals”.

PART 3 -- EXECUTION

3.1 RIGHT-OF-WAY

A. The Contractor shall confine his area of operations to the space within the boundaries of the easements and property lines shown on the plans.

B. The Contractor shall be held responsible for unnecessary damage to all the existing facilities. Care shall be used to avoid injury to property.

C. It shall be the responsibility of the Contractor to comply with local road restrictions.

D. Work in agricultural areas shall be limited to the easement area to avoid any crop damages being claimed.

3.2 ESTABLISHING LINE AND GRADE

A. Survey control monuments, benchmarks, or other reference points shall be protected. If damaged or destroyed through the negligence of the Contractor, they shall be replaced at the Contractor's expense.

B. The Engineer shall provide qualified personnel and the necessary equipment to properly set horizontal and vertical control stakes for laying out the various structures and piping. The Engineer will provide a benchmark for vertical control and baselines in N-S and E-W directions with offsets to buildings and structures.

C. The property boundary corners, or survey control points, shall be set by the Engineer.

D. In the event of apparent or questionable errors or inconsistencies in such stakes or references set for the control of line and/or grade, the Contractor shall promptly notify the Engineer of such error or inconsistency and shall not proceed with the work until such stake, grade or mark has been verified or corrected by the Engineer.

3.3 INTERFERENCE OF UNDERGROUND STRUCTURES

A. The Contractor shall protect from damage all existing sanitary sewer and sanitary sewer manholes, storm sewer and storm sewer manholes, gas lines and regulators, watermains, watermain valve boxes, underground or overhead telephone wires or cables, underground or overhead electric wires or cables, and all other similar utilities, including service connections, curb, gutter, and sidewalk, except as required to be removed for the actual construction of the project. See Reference Specification CEAM 2621.3A2.

B. The existing utilities must remain in service throughout the construction period. The Contractor shall provide all labor, equipment, and appurtenances to perform this requirement properly. This work shall be considered incidental to the construction.

C. The utility information shown on the plans may not be completely accurate and is furnished from information supplied by the various utility companies and the OWNER as an indication of the presence of utility lines in the vicinity of construction. It is the sole responsibility of the Contractor to contact the utility companies to determine the extent and exact location of their facilities and to ascertain whether they are likely to be affected by the construction. The Contractor shall review with them the location of any and all of their utilities and improvements within the project limits and shall discuss his intended progress. In the event of accidental or necessary damage to any such facility, he shall immediately notify the utility company and shall cooperate fully in whatever is necessary to

repair such facility or restore service. Exploratory excavation shall be coordinated with the utility companies to ensure the exact locations.

D. The Contractor shall assume full responsibility for all damages to the property of such character, resulting from any act, omission, neglect, or misconduct in the execution or non-execution of the work, except that he will not be held responsible for damage to underground property within the right of way of its existence and the approximate location was not made known to the Contractor before the damage was done. To the extent of his liability and his own expense, the Contractor shall restore damaged property to a condition equal to that existing before the damage was done by repairing, rebuilding, or replacing it as directed, or he shall otherwise compensate for the damage in an acceptable manner.

E. Any services which are cut or otherwise damaged shall be repaired and/or rebuilt with the same materials or structurally heavier material than that which the service is constructed.

F. It is recommended that the Contractor conduct exploratory excavations ahead of the construction to locate utilities and reduce conflicts that may affect the progress of the project. These excavations are at the Contractor's expense unless the excavations are requested by the OWNER.

G. Existing sanitary sewer or storm sewer pipes that are not removed shall be abandoned. Plug all open ends with brick and mortar or concrete. This will be considered incidental work.

3.4 PROTECTION OF SURFACE IMPROVEMENTS

A. The Contractor shall provide protection during construction for buildings, structures, street crossings, and other facilities located within the construction and/or perpetual easement areas which are not noted to be removed in the plans.

B. The Contractor shall protect existing trees, shrubs, lawns, utilities, buildings, and other features or facilities, on or adjacent to the site from damage where such items are not designated to be removed. The Contractor shall replace damaged items at his own expense.

C. No direct compensation shall be paid to provide the necessary protection (such as sheeting, shaping, bracing, tunneling, etc.) for the facilities. This work shall be considered incidental to the project.

D. The Contractor shall exercise extreme care in constructing that segment of the relief sewer constructed on private property. Contact landowners prior to entering their property. Property damage shall be corrected by the Contractor at his expense.

3.5 REMOVAL OF SURFACE IMPROVEMENTS

A. The Contractor shall refer to CEAM Specification 2621.3A4.

B. Concrete surfaces shall be sawed prior to excavation of the trench unless a construction joint is convenient to the trench limits.

C. Bituminous street surface shall be sawed or cut, as stated in the referenced specification, prior to the excavation of the trench.

D. Trees to be cleared and grubbed are shown on the plans. In general, the work shall be done as described in MnDOT Specification 2101. Brush shall be cleared and grubbed; the cost for doing so shall be incidental to the construction of the project. Trees shall be determined by counting the number of trees cleared which measure more than four (4) inches in diameter at a point two (2) feet above the ground surface. Trees of smaller diameter shall be considered as brush.

3.6 SHEETING AND BRACING EXCAVATION

A. The Contractor shall refer to CEAM Specification 2621.3B4.

B. All excavations shall be sheeted, shored, and braced as will meet all requirements of the applicable safety codes and regulations; comply with any specific requirements of the Contract; and prevent disturbance or settlement of adjacent surfaces, foundations, structures, utilities, and other properties. Any damage to the work under contract or to adjacent structures or property caused by settlement, water or earth pressures, slides, cave-ins, or other causes due to failure or lack of sheeting, shoring, or bracing or through negligence or fault of the Contractor in any manner shall be repaired at the Contractor's expense and without delay.

C. Where conditions warrant extreme care, the Plans, Specifications, and Special Provisions may require special precautions to protect life or property, or the Engineer may order the installation of sheet piling of the interlocking type or direct that other safety measures be taken as deemed necessary. Failure of the Engineer to order correction of improper or inadequate sheeting, shoring, or bracing shall not relieve the Contractor's responsibilities for the protection of life, property, and work.

D. The Contractor shall assume full responsibility for proper and adequate placement of sheeting, shoring and bracing, wherever and to such depths that soil stability may dictate the need for support to prevent displacement. Bracing shall be arranged so as to provide ample working space and so as not to place stress or strain on the in-place structures to any extent that may cause damage.

E. Sheeting, shoring, and bracing materials shall be removed only when and in such a manner as it will ensure adequate protection of the in-place structures and prevent displacement of supported grounds. Sheeting and bracing shall be left in place only as required by the Plans, Specifications, and Special Provisions or ordered by the Engineer. Otherwise, sheeting and bracing may be removed as the backfilling reaches the level of respective support. Wherever sheeting and bracing are left in place, the upper portions shall be cut and removed to an elevation of three feet or more below the established surface grade as the Engineer may direct.

F. All costs of furnishing, placing, and removing sheeting, shoring, and bracing materials, including the value of materials left in place as required by the Contract, shall be incidental to the CONTRACT and will not be compensated for separately.

3.7 PREPARATION AND MAINTENANCE OF FOUNDATIONS

A. The Contractor shall perform any dewatering of the area excavated at his own expense.

B. Bedding required to stabilize the trench bottom shall be incidental to the construction of the project.

C. Coarse rock bedding or granular encasement of the PVC pipe is required and shall be considered incidental to the cost of the pipe in place. The bedding and encasement zone shall extend from 6 inches below the pipe barrel to 1 foot above the pipe barrel.

**** END OF SECTION ****

SECTION 02 30 00 - SUBSURFACE INVESTIGATION

PART 1 -- GENERAL

1.1 GENERAL

A. It shall be the responsibility of the Contractor to examine the site of the project and become familiar with all site conditions relating to the construction of the project.

B. The Contractor shall accept the site in the condition it is in.

1.2 SOIL INFORMATION

A. Soil borings have been made on the construction sites. Copies of the data obtained are found in Appendix A. The information contained in the above-referenced document is being made available to the Contractor solely for his information and convenience. The information and data contained in the referenced document do not constitute a part of the Contract.

B. Neither the OWNER nor the Engineer represents that the information being made available shows the complete range of conditions that will be encountered in the construction of the Project. The information furnished in the referenced document represents only the opinion of the OWNER and the Engineer as to the character of materials encountered during field investigations. All surface water and groundwater levels indicated in the soils report refer to levels at the time of the field investigation only.

C. The OWNER and the Engineer disclaim responsibility for any opinions, conclusions, interpretations, or deductions that may be expressed or implied in any of the information and data contained in the referenced document. It is expressly understood that the making of deductions, interpretations, and conclusions is the Contractor's sole responsibility.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 02 41 00 - DEMOLITION OF EXISTING WASTEWATER TREATMENT FACILITIES

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. CONTRACTOR shall accomplish demolition and related work as described below and as shown on the plans.

B. All the structures have been exposed to wastewater and may have biological growth. All work related to the disposal of such material shall be incidental.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 11 00 - Summary of Work

B. Section 01 57 00 - Temporary Environmental Controls

C. Section 02 41 00 - Selective Demolition

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 SCHEDULE

A. The CONTRACTOR shall schedule the demolition of the existing wastewater treatment facilities shown on the Contract Drawings after the new treatment facility is operational to the OWNER'S satisfaction or as required for the sequence of construction.

3.2 DEMOLITION OF EXISTING WASTEWATER TREATMENT FACILITIES

A. The OWNER may wish to salvage equipment from the existing wastewater treatment facilities.

B. All property not salvaged by the OWNER shall become the property of the CONTRACTOR and shall be removed and disposed of by the CONTRACTOR unless otherwise directed.

C. The CONTRACTOR shall break up the bottom slabs of existing wastewater treatment structures and make them not suitable for water retention and then may proceed to fill up these structures with materials to be disposed of. All excess materials which cannot be contained in these structures shall be removed from the site and properly disposed of.

D. The CONTRACTOR shall remove all other existing equipment, exposed piping, and miscellaneous items in the existing wastewater treatment facilities.

E. The CONTRACTOR shall abandon all utility service lines to the existing wastewater treatment buildings.

F. Trenches and tunnels left by the removal of any services or pipelines shall be filled and compacted to match existing ground elevation. Backfilling shall comply with Section 31 23 00.

G. The CONTRACTOR shall remove all existing electrical fixtures, wiring, conduits, switchgear, heating ventilation, and plumbing equipment not salvaged by the OWNER.

H. The CONTRACTOR shall remove building frames and demolish the building walls, level the site, and landscape as shown on the plans.

I. The CONTRACTOR shall take great care that no damage is caused by dust or water during demolition.

J. Any adjacent facilities damaged during demolition shall be restored to original condition by the CONTRACTOR at no expense to the OWNER.

**** END OF SECTION ****

SECTION 02 41 13 - REMOVING PAVEMENT AND MISCELLANEOUS STRUCTURES

PART 1 -- GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to the removal of pavement and miscellaneous structures as indicated in the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Measurement and compensation for the following items shall be included in the LUMP SUM bid.

1. Saw cutting - bituminous and/or concrete, driveways, sidewalks, pavements, curb and gutter, and other impervious surfaces.
2. Disposal of excess excavated material and debris.
3. Removal and disposal of bituminous or concrete pavement, unless designated for salvaging.
4. Removing, salvaging and storing, or disposing of manhole and catch basin castings.
5. Loading, hauling, stockpiling, and placing as directed (i.e., leveling) designated salvage items to a location directed by the Owner.
6. Fees and permits for the disposal of materials.
7. Removal and disposal of existing sanitary sewer pipe, storm sewer pipe, watermain, and service pipes.
8. Bulkheading the ends of existing pipes designated by the Engineer to be abandoned in place.
9. Protection from damage of structures or other surface improvements that are not to be removed, and subsequent repair and/or replacement if damaged by Contractor operations.

1.3 SPECIFICATIONS REFERENCES

A. MnDOT Specification Section 2104 shall apply to the removal of pavement and miscellaneous structures, except as modified herein.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. No exception to the referenced specification is made.

PART 2 -- PRODUCTS

2.1 NO EXCEPTION TO THE REFERENCED SPECIFICATION IS MADE.

PART 3 -- EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Remove existing bituminous, curb and gutter, walks, drives, steps, and other specified items where shown on the plans and/or required for the construction of the project.

B. Saw cut bituminous and concrete surfaces prior to excavation, to produce a clean-cut breakage joint.

C. Dispose of all concrete and bituminous removal items, rubbish, and debris outside of the construction zone. It shall be the Contractor's responsibility to secure all required permits and pay all fees associated with the disposal of the material and securing the disposal site.

D. The Contractor shall take full responsibility to protect structures or other surface improvements from damage that are not to be removed. If damage to these facilities occurs due to the construction of the project, the Contractor shall replace or repair them.

E. The Owner will designate which existing hydrants, valves and boxes, manhole castings, and other items removed as part of the construction, are to be salvaged. All other items shall be disposed of by the Contractor.

F. In general, all existing watermain, sanitary sewer, and storm sewer pipes being replaced by new improvements shall be considered as debris and removed during the construction process. In certain instances, existing pipes may be abandoned in place, with the approval of the Engineer.

G. Where existing pipes are to be abandoned in place, the exposed pipe ends shall be bulkheaded shut with a watertight non-shrink concrete grout at a thickness of not less than one pipe diameter.

****END OF SECTION****

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.

2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 11 00 - Summary of Work

B. Section 01 50 00 - Construction Facilities and Temporary Controls

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed.

E. Abandon In-Place: Detach from existing construction, break-up for drainage, fill with granular material or grout, cap, or otherwise modify as indicated and leave in-place.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.6 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

5. Review areas where existing construction is to remain and requires protection.

6. Review and finalize protection requirements.
7. Review procedures for noise control.
8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.7 INFORMATIONAL SUBMITTALS

A. Survey of Existing Conditions: Show existing conditions of adjoining construction and site improvements, including finish surface that might be misconstrued as damage caused by selective demolition operations. Submit photographs and/or videos before work begins.

B. Visual Observation Report: For adhesion, water damage, alkaline deposits, and other defects found during demoltion.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.8 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.9 FIELD CONDITIONS

A. Owner will [not]occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.
    a. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. On-site sale of removed items or materials is not permitted.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.

2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 - Construction Facilities and Temporary Controls.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

3.4 SALVAGE/REINSTALL

A. Removed and Salvaged Items:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.

3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

4. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove items and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete:

1. Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
2. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

****END OF SECTION****

SECTION 03 01 30 - CONCRETE REHABILITATION

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall restore/rehabilitate the existing structures as described below.

1.2 SUMMARY OF WORK

A. Miscellaneous repair for existing structures.

B. For bidding purposes, assume 500 SF where troweling is required and 100 SF where forming and pouring are required. These concrete rehabilitation areas are in addition to repairs associated with selective demolition.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. For concrete repair on existing structures where troweling is required:

1. Remove all loose concrete.
2. Sandblast the entire area to be repaired.
3. Hand trowel area with SikaTop 126 Plus, or equal (1/4” minimum-2” maximum per lift).
4. If reinforcing steel is exposed, a bonding agent, SikaArmatec 110 or equal shall be applied prior to applying the SikaTop 126 Plus.

B. For concrete repair on existing structures where forming and pouring are required:

1. Remove all loose concrete.
2. Sandblast the entire area to be repaired.
3. Form areas as required.
4. Pour SikaTop 111 Plus or equal. (1/2” minimum depth.)
5. If reinforcing steel is exposed, a bonding agent, SikaArmetec 110, or equal, shall be applied prior to applying the SikaTop 111 Plus.

PART 3 -- EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. All repair/rehabilitation work should be done to the satisfaction of the ENGINEER.

B. Placement of concrete repair products shall be per the manufacturer’s recommendation.

**** END OF SECTION ****

SECTION 03 11 00 - CONCRETE FORMWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. All formwork shall comply with all the recommendations of ACI 347 “Recommended Practice for Concrete Formwork” except as modified herein.

B. The CONTRACTOR shall assume full responsibility for the design and construction of all formwork.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ACI 117 Specifications for Tolerances for Concrete Construction and Materials.

ACI 301 Specifications for Structural Concrete for Buildings.

ACI 347 Recommended Practice for Concrete Formwork.

1.3 QUALITY ASSURANCE

A. The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work conforms to the shape, line, grade, and dimensions as shown in the drawings. Formwork tolerances shall not exceed permissible deviations given in ACI 117. Use Class A formwork facing material offset. Use “very flat floor” finishing tolerance. See Section 03 30 00, 1.5 D. for additional construction tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. For all concrete surfaces to be unexposed, form surfaces that will be in contact with concrete shall be of No. 2 common or better lumber or other material producing equivalent finish.

B. For all concrete surfaces to be exposed, finishes shall be as specified in Section 03 30 00 “Finish for Concrete Walls”.

C. Form ties shall be factory-fabricated, snap-off metal ties of design that will not allow form deflection and will not spall concrete upon removal. Wire ties will not be permitted. Ties shall be free of devices that will leave a hole larger than 1 inch or less than 1/2-inch in diameter in the concrete surface. The portion of the tie remaining in the concrete after removal of the exterior parts shall not project beyond the surface of the concrete and shall be at least 1-1/2 inches back from any surface of the concrete that will be exposed, painted, damp-proofed, waterproofed, or receive direct applications of plaster.

D. Forms for exposed or painted surfaces shall be coated with a form release agent before reinforcement is placed. The form release agent shall be a commercial formulation of satisfactory and proven performance that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces. The release agent shall be used as recommended in the manufacturer’s printed or written instructions. Forms for unexposed surfaces, other than retained in-place metal forms, may be wet with water in lieu of coating immediately before placing

concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus debonding agents on form surfaces, reinforcing steel, and construction joints shall be removed before the concrete is placed.

E. Prior to coating with the above-specified release agent, wood forms shall be sealed with a penetrating type wood sealer. The sealer shall be applied in strict accordance with the manufacturer's recommendations.

2.2 DESIGN

A. Formwork must be designed, constructed, supported, braced, and maintained so that it will safely support all dead and live loads to which it may be subjected. Formwork shall be sufficiently tight to prevent leakage of mortar so that finished concrete will conform to shapes, lines, grades, and dimensions indicated in the drawings.

B. The weight of the formwork, freshly placed concrete, workmen and equipment, rate of placement and temperature, tamping, and vibration of the concrete shall all be considered in the design of the formwork. Forms and falsework to support roof and floor slabs shall be designed for a loading of at least that required by ACI 347.

PART 3 -- EXECUTION

3.1 CONSTRUCTION

A. **Formwork** - Forms shall be designed, constructed, and maintained to ensure that after the removal of forms, the finished concrete members will have true surfaces free of deformities or bulges, conforming accurately to the indicated shapes, dimensions, lines, elevations, and positions. Recommendations given in ACI 347 shall be followed. Form surfaces that will be in contact with concrete shall be thoroughly cleaned before each use.

B. **Studs** - Studs shall be spaced to prevent deflection of form material. Forms and joints shall be sufficiently tight to prevent leakage of grout and cement paste during the placing of concrete. Joints in forms shall be arranged vertically or horizontally to conform to the pattern of the design. Insofar as practicable, the juncture of formwork panels shall occur at architectural lines and vertical control joints, including alignment with masonry control joints and construction joints. Forms placed on successive units for continuous surfaces shall be fitted to accurate alignment to ensure smooth, completed surfaces free from irregularities. Temporary openings shall be arranged in the wall and column forms and where otherwise required to facilitate cleaning and inspection. Forms shall be readily removable without impact, shock, or damage to the concrete.

C. **External Corners** - External corners of columns, girders, beams or their juncture with masonry, foundation walls projecting beyond overlying masonry, and other external corners that will be exposed shall be beveled, rounded, or chamfered by moldings placed in the forms unless the drawing specifically states that chamfering is to be omitted.

3.2 FORM TIES

A. **Embedded Ties:** Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such a manner as to leave a hole extending through the interior of the concrete members. The use of snap ties that cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent the loss of cement paste. Where metal rods extending through the concrete are

used to support or strengthen forms, the rods shall remain embedded and shall terminate not less than 1-1/2 inches back from the formed face or faces of the concrete.

B. **Removable Ties:** Where taper ties are approved for use, after the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bonding. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink or regular cement grout. Exposed faces of walls shall have at least the outer 2 inches of the exposed face filled with cement grout which shall match the color and texture of the surrounding wall surface. The CONTRACTOR shall be responsible for water-tightness and any repairs needed.

3.3 FORM REMOVAL

A. Forms shall be removed in a manner that ensures the complete safety of the structure. Where the structure as a whole is supported on shores, forms for beam and girder sides, columns, and similar vertical structural members may be removed after 48 hours, provided the concrete is sufficiently hard not to be injured thereby. Supporting forms or shoring shall not be removed until structural members have acquired sufficient strength to support safely their own weight and any construction and/or storage load to which they may be subjected, but in no case shall they be removed in less than 7 days, nor shall forms used for curing be removed before the expiration of curing period. Care shall be taken to avoid spalling the concrete surface or damaging concrete edges. Wood forms shall be completely removed.

B. Supporting forms or shoring shall not be removed until the strength of control test specimens has attained a value of at least 3,000 psi for column and 3,000 psi for all other work. Test specimens required for control tests to determine form removal time shall be provided in numbers as directed and shall be in addition to those otherwise required for concrete control. Test specimens shall be removed from molds after 24 hours and stored adjacent to that portion of the structure which they represent and shall receive, insofar as practicable, the same protection from the elements during curing as is given those portions of the structure which they represent and shall not be removed from the structure for transmittal to the laboratory prior to the expiration of three-fourths of the proposed period before removal of the forms. Care shall be exercised to ensure that the newly unsupported portions of the structure are not subjected to heavy construction or material loading.

C. Forms for all parts of the work not specifically mentioned herein shall remain in place for periods of time as determined by the ENGINEER.

D. Recommendations for shoring given in ACI 347 shall be followed for all re-shoring.

**** END OF SECTION ****

SECTION 03 20 00 - CONCRETE REINFORCEMENT

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. CONTRACTOR shall include all the necessary ties, chairs, and accessories required for support and spacing of the reinforced steel, reinforcement in masonry bond beams, all mesh columns, and end reinforcing as detailed.

B. All concrete and steel have been designed to conform with ACI 318, and details on all steel shall conform therewith and with Chapter 5 of ACI 301.

C. Fabrication tolerances, placement, detailing, and estimating practice shall be in accordance with the "Manual of Standard Practice", latest edition of the CRSI, and as covered in Chapter 8, "Placing Reinforcing Bars".

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ACI 301	Specifications for Structural Concrete
ACI 315R	Guide to Presenting Reinforcing Steel Design Details
ACI 318	Building Code Requirements for Structural Concrete
A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A615	Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
AWS D1.4	Structural Welding Code – Steel Reinforcing Bars

1.4 SUBMITTALS

A. CONTRACTOR shall submit shop drawings to the ENGINEER in accordance with Section 01 33 00 for approval prior to fabrication. Sizes, dimensions for fabrication and diagram for placement of bars, and type and location of all accessories shall be indicated. No fabrication shall proceed on any section until approved drawings are received on such section.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Deformed Billet steel bars shall conform to ASTM A615, Grade 60, as shown in engineering notes on the structural detail plans.

B. Welded steel wire shall conform to ASTM A1064. Wire size and location are shown on the plans.

C. Chairs for slabs exposed to view shall be plastic-coated steel, or approved equal, to prevent rust stains on the exposed concrete.

2.2 SPACERS

A. Provide spacers with tie wire at proper intervals to hold slab bars in position and to raise them above forms to distances shown. Support reinforcing on bolsters or chairs and carrying bars whether or not specifically called for in drawings. Provide wire bar type supports complying with ACI 315R, unless otherwise indicated. Do not use wood, brick, and other unacceptable materials.

PART 3 -- EXECUTION

3.1 FABRICATION

A. Reinforcing bars shall be bent cold, in the shop, with proper equipment for making cold bends. Field bending of reinforcement will not be allowed.

3.2 CLEANING AND STORAGE

A. Reinforcement upon delivery and before installation shall be cleaned and free of rust, scale, dirt, grease, oil, snow, ice, etc.

B. Reinforcement shall be protected from rusting in storage. Steel having deposits of scale will be rejected.

3.3 PLACEMENT

A. Reinforcement shall be placed accurately according to the plans and secured in position by approved accessories. The minimum clear distance between parallel bars shall not be less than 1-1/2 times the normal size of the coarse aggregate and shall be as required by ACI 318.

B. No splices of reinforcement shall be made except as shown on the plans or as specified or authorized by the ENGINEER. Reinforcing shall be kept in the proper position during concrete placement.

3.4 REINFORCEMENT COVER

A. The reinforcement shall be protected by the thickness of concrete indicated on the plans. Where not shown otherwise, concrete coverage over the reinforcement shall be as follows:

Location of Reinforcement	Cover
Surfaces where concrete is deposited directly against the ground (footings)	3” Clear bottom and sides
Formed surfaces exposed to the ground, water, or weathering (walls)	2” - Both faces
Beams, girders, and columns	1-1/2” - Clear to ties or stirrups
Joists, slabs	1” Bottom and top

B. Exposed reinforcing bars intended for bonding with future extensions shall be protected from corrosion by concrete or other adequate approved coverings, or as shown in the drawings.

**** END OF SECTION ****

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. Concrete has been designed to conform to ACI 318 (latest edition). Concrete construction shall also conform to ACI 301 and ACI 350. Except where this SECTION varies therewith, such publications are hereby made a part of this specification.

B. Except as mentioned in Paragraph 1.2, this section shall include (but is not limited to) the following:

1. Footings and foundation walls of all descriptions.
2. Installation of a vapor barrier under concrete floors of buildings on gravel fill.
3. Bases, pads, and footings for equipment.
4. Concrete fill in the concrete block and bond beams.
5. Concrete accessories and building in cast-in-place items furnished under other sections.
6. Dovetail insert slots as necessary for masonry.
7. All design mixes and tests.
8. Expansion joints in concrete.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 45 00 Testing and Inspection

B. Section 03 11 00 Concrete Formwork

C. Section 07 27 00 Vapor Barrier

D. Section 26 05 00 Common Work Results for Electrical (Conduit and Fittings)

E. Section 40 23 00 Process Piping and Pipe Fittings (Pipe Sleeves and Inserts)

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ACI 211.1	Recommended Practice for Selecting Proportions
ACI 212.2R	Guide for Use of Admixtures in Concrete
ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete
ACI 304	Recommended Practice for Measuring, Mixing, and Placing Concrete
ACI 305.1	Specification for Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 308	Recommended Practice for Curing Concrete
ACI 315R	Guide to Presenting Reinforcing Steel Design Details
ACI 318	Building Code Requirements for Structural Concrete
ACI 347	Recommended Practice for Concrete Formwork

ACI 350R	Concrete in Sanitary Engineering Structures
ASTM C31	Methods for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Specification for Concrete Aggregate
ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Specification for Ready-Mixed Concrete
ASTM C143	Test Method for Slump of Portland Cement Concrete
ASTM C150	Specification for Portland Cement
ASTM C192	Methods for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C260	Specifications for Air-Entraining Admixtures for Concrete
ASTM C494	Specifications for Chemical Admixtures for Concrete
ASTM C618	Specification for Fly Ash
ASTM C989	Specification for Slag Cement

1.4 SUBMITTALS

A. All submittals shall be in accordance with Section 01 33 00 “Submittals” and shall be made for products specified in this section.

B. **Mix Design:** The CONTRACTOR shall submit a design mix at least 3 weeks prior to scheduled concrete placement for each type and strength of concrete used for compliance with the specifications.

C. **Admixture:** When a water-reducing admixture is to be used, the CONTRACTOR shall furnish mix designs for concrete with admixture.

D. **Shrinkage Test Results:** Refer to Part 2.2.B of this Section.

E. **Independent Testing Laboratory Review:** An Independent Testing Laboratory that is familiar with local aggregates, cement, fly ash, and admixtures shall design or complete a design review and provide a recommendation of Mix Designs No. 1 and 2. Any changes to Mix Designs No. 1 and 2 after review and approval shall require an additional review and approval. The review shall include the following items at a minimum:

1. Review the Akali Silica Reactivity (ASR) potential of proposed aggregates. Independent Lab shall state no reasonable potential for ASR or complete ASR testing per ASTM 1260.
2. Review the deleterious materials content of the proposed aggregate.
3. Review the mix design, cement, aggregate, and shrinkage test results to meet shrinkage requirements.
4. Review the concrete mix designs to meet strength requirements.
5. Review the compatibility of proposed admixtures.

F. **Certified Delivery Tickets:** Where ready-mix concrete is used, the CONTRACTOR shall provide delivery tickets at the time of delivery of each load of concrete. Each certificate shall show the total quantities by weight of cement, sand, each class of aggregate, admixtures, and the total gallons of water in the load. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of the day when the batch was dispatched. Quantity of water to be added at the site and still not exceed the water-cement ratio of the mix.

1.5 QUALITY ASSURANCE

A. Tests on component materials and for compressive strength of concrete will be performed as specified herein. Concrete density by ASTM C138, air content by ASTM C231/C173, and concrete temperature by ASTM C1064 as per ACI 301.

B. Slump

1. Slump test will be done in accordance with ASTM C143.

(a) The concrete shall be designed for as low a slump as is practical to fill the form, embed the reinforcing steel, and be free of voids or honeycomb. Use a lower range for machine vibration. The slump shall be as specified in paragraph 2.2C.

2. Slump shall be measured for each mixed batch of concrete or each load delivered to the site.

C. Compression Tests

1. ENGINEER will take one (1) set of concrete cylinders for each day's pour of 25 cubic yards or less, plus one set for each additional 50 cubic yards poured on that day. Cylinders shall be of representative concrete, taken from mixer discharge at the actual time of pouring. OWNER will pay all costs of preparing, transporting to a laboratory, and making of tests. All such tests shall be made at an independent testing laboratory approved by the ENGINEER. The CONTRACTOR shall assist the ENGINEER in making the test cylinders.

2. Each set shall consist of 3 cylinders for 28-day strength testing and additional cylinders if 7-day and 10-day strengths are required. Per ACI two cylinders are to be tested at 28 days, and the average of the two is to be used for determining conformance. The hold cylinder (3rd cylinder) will be tested if the 28-day value is less than the specified strength.

3. Remaining test requirement shall follow ACI 318, except that if the average strength of any set of job-cured cylinders falls below the required strength, the cost of any additional cement necessary to correct subsequent mixes shall be borne by the CONTRACTOR. Also, if the strength is found deficient, the cost of hardened concrete or load tests shall be borne by the CONTRACTOR. The ENGINEER reserves the right to reject any portions of such questionable areas if, in his opinion, the tests indicate that such areas will not safely carry the design loads.

4. All concrete that fails to meet these specifications is subject to removal and replacement at the cost of the CONTRACTOR.

D. Construction Tolerances

1. Finish concrete shall meet the following tolerances:

(a) Variations from plumb: .....± 1/4-inch per 10 feet but not more than 1-inch maximum for the entire length

(b) Variations from level or indicated grade:.....± 1/4-inch per 10 feet but not more than 1/2-inch for the entire length

(c) Variations from horizontal: .....± 1/4-inch per 10 feet but not more than 1/2-inch total variation

(d) Variations in size and locations of openings or sleeves: ....±1/4-inch

(e) Reinforcing steel placement: .....ACI 318, Section 7.5.2

Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 347.

E. Leakage Testing

1. Water retaining concrete tanks shall be leak tested as specified in Section 01 45 00 “Testing and Inspections”.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. CONTRACTOR shall be responsible for the delivery, storage, and handling of products.

B. Products that are discovered to be unsuitable for the intended use shall be removed promptly from the job site.

1.7 JOB CONDITIONS

A. Methods outlined in ACI 306.1, Standard Specification for Cold Weather Concreting, shall be followed if the concrete is to be placed when the ambient temperature is expected to be less than 40°F.

B. Methods outlined in ACI 305.1, Specification for Hot Weather Concreting, shall be followed if the concrete is to be placed when the ambient temperature is expected to exceed 90°F.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Cement

1. The Portland cement to be used shall meet the conditions of ASTM Specification C595 for Type 1L-MS. All cement shall be from the same manufacturer and from the same plant. High early-strength cement may be used only upon the Engineer's approval.

2. Testing compliance for the moderate sulfate (MS) designation shall be by ASTM Method C452.

3. The C_3A content of the Portland cement shall be less than 8 percent in all concrete. Where aggregates are alkali reactive, a cement containing less than 0.60 percent alkalies shall be used. If the Contractor wishes to use Cement with higher C_3A content and fly ash or slag cement to reduce ASR and increase the sulfate resistance, then the contractor, prior to bid, shall submit a detailed proposed mix design with expected shrinkage at 28 days, and the compressive strength at 7, 15 and 28 and 42 days. The use of the proposed mix design shall be approved at least seven (7) days prior to the bid.

4. Concrete forms shall not be removed before the concrete reaches 3000 psi strength. The use of high cement content to reach high early strength would increase the drying shrinkage of the concrete mix.

5. The cement content of the mix shall be adjusted to limit the drying shrinkage to 0.04% at 28 days of air drying. The test beam shall be water cured for 7 days and then air-dried (Modified ASTM C157). Shrinkage Reducing Admixtures to meet this requirement shall be provided at no additional cost to the OWNER. Concrete mix with higher 28-day strength and poor workability but passing the shrinkage requirements would not be accepted. The contractor will be responsible for delivering a concrete mix that could be finished as intended.

6. If Fly Ash is approved, it shall meet the requirements of ASTM C618, Class F. If slag cement is approved, it shall meet the requirements of ASTM C 989. If Fly Ash or Slag cement is approved for providing sulfate resistance, then the maximum water-cement ratio is reduced to 0.42, and the minimum compressive strength of Mixes 1, 2 & 3 in Paragraph 2.2 below is increased to 4500 psi as specified by ACI 350 for moderate sulfate exposure. If fly ash is used, it shall not exceed 25% of total cementitious material by weight. If slag cement conforming to ASTM C 989 is used, it shal

l not exceed 30% of total cementitious material by weight. The total of fly ash and other pozzolans and slag cement shall not exceed 40% of the total cementitious material by weight.

7. Class C fly ash shall not be used in Mix Designs No. 1 or 2 under any circumstances.

B. Aggregate

1. All fine and coarse aggregate shall be natural sands and gravels or crushed stone that is washed, cleaned, and conforming to ASTM C33 and shall be free of shale, chert, coal, iron oxide, and other deleterious materials.
2. Aggregate shall have passing test results for ASTM C-1260 and ASTM C-1778 tests for potential alkali reactivity of aggregates.
3. Total fine and coarse aggregate lightweight particle content shall be less than 0,5% of total weight (dry basis) per ASTM C123 and ASTM C142 test methods.
4. The maximum size of coarse aggregate shall not be larger than one-fifth of the narrowest dimension between forms of the member for which the concrete is to be used, nor larger than three-fourths of the minimum clear spacing between reinforcing bars. The coarse aggregate shall conform to Table II of ASTM Specification C33. Use 1-1/2-inch aggregate for structures requiring low shrinkage in lieu of ¾" aggregate (use Mix No. 1 instead of Mix No. 2.).
5. Fine Aggregate: Shall Conform to ASTM C33. Fine aggregate applied to concrete floor topping shall pass No.4 sieve, and not more than 10% shall pass Sieve No.100.

C. Water

1. Water shall be potable, clean, and free from strong acids, alkalies, oils, or organic materials and meet ASTM C1602, "Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete".

D. Admixtures (Air-entrained Concrete)

1. Admixtures for air-entrained concrete shall be used for sidewalks and all concrete exposed to the weather and water/wastewater retaining structures.
2. Water Reducing Admixtures shall meet the requirements of ASTM C494, Type A, and shall not contain any chloride ions except a trace amount.
3. Water Reducing and Retarding Admixtures shall meet the requirements of ASTM C494, Type D, and shall not contain any chloride ions except a trace amount.
4. High-Range Water-Reducing Admixture (Super Plasticizer) shall meet the requirements of ASTM C494, Type F or G, and shall not contain any chloride ions except a trace amount.
5. Air-entraining admixtures shall meet the requirements of ASTM C260.
6. The content of air-entrained concrete shall be 5 to 6 percent for concrete with 3/4" maximum size aggregate and 4 ½ to 5 ½ percent for concrete with 1-1/2" maximum size aggregate.
7. Manufacturer or Equal:
   (a) Darex or Daravair Series, by GCP Applied Technologies (W. R. Grace & Co.)
   (b) Toch Toxement AEA
   (c) Sika AEA
   (d) Protex

E. Chemical Admixture

1. The use of chemical admixture shall be in accordance with ACI 212.2R and shall be approved by the ENGINEER.
2. The admixture shall meet the requirements of ASTM C494 as specified above.
3. No chlorides shall be used.
4. Shrinkage Reducing Admixture (SRA)
   (a) The concrete shall be in compliance with the modified version of ASTM C157-17 where the maximum drying shrinkage shall not exceed 0.040% in 28 days following a 7-day submersion period (see table following section 2.2c herein for applicability).
   (b) Manufacturer:
      (1) Eclipse 4500, by GCP Applied Technologies (W. R. Grace & Co.) or equal.

F. Expansion Joints

1. Expansion joints in walks, curbs, and along edges of the wall between the floor and walls shall be pre-molded cork and asphalt.
2. Manufactures or Equal:
   (a) Brock White #3720

G. Waterstops

1. PVC water stops shall be provided as shown in the drawings and meet the CORPS OF ENGINEERS specification CRD-C572.
2. All water stops shall be 4” minimum. 6-inch water stops shall be used in all wall joints. The water stops shall meet the clearance requirements shown in the drawings.
3. Waterstops shall be applied continuously, and all joints heat welded.
4. Waterstops shall be tied in place prior to pouring concrete as recommended by the manufacturer.
5. Manufacturer or Equal:
   (a) Greenstreak
      (1) Style 732 (Horizontal Joints)
      (2) Style 732 or 703 (Vertical Joints); Style 703 is to be used only at locations where Style 732 cannot be used due to crowded rebar placement.
      (3) Style 790 for Labyrinth (Attached Joints)
      (4) Style 738 (Expansion Joints)

H. Non-Shrink Grout

1. All grout shall be non-metallic and non-gaseous, which can be poured, pumped, or damp-packed. The grout shall be suitable for both interior and exterior applications. It shall be non-shrink when tested in accordance with ASTM C1107 at a fluid consistency of 20-30 seconds.
2. The grout shall be a one-step product delivered to the job site in bags containing a premixed formulation requiring only the addition of water prior to use.
3. Precision non-shrink grout shall be used on all pumps, blowers, and equipment bases.

4. Manufacturer or Equal:

   (a) General Purpose: (attain 7000 psi strength in 28 days)

      (1) Masterflow 713

      (2) Duragrout - L & M 14K

      (3) Five Star Grout

   (b) Pump Bases, Equipment Pads: (shall attain 9000 psi strength in 28 days)

      (1) Masterflow 928

      (2) Crystex - L & M

      (3) Five Star Grout

I. Concrete Grout

1. Concrete grout shall be proportional with cement, fine and coarse aggregates, water, water reducer, and air-entraining agent to produce a mix having an average strength of 3000 psi at 28 days. The slump should not exceed 5 inches and should be low as practical and yet retain sufficient workability.

J. Cement Grout

1. Cement grout shall be a mixture of one-part Portland cement to 1 or 2 parts sand with sufficient water to place the grout. The water content shall not allow the grout to flow.

K. Water Plug

1. Water plug shall be used to seal any unused existing pipe penetration openings, and seepage through floors and walls.

2. Manufacturer or equal

   (a) Brock White C-7160

L. Curing Materials

1. Chemical curing compound: Blend of sodium, meta, and potassium silicates that effectively cure the concrete, leaving surfaces residual and membrane-free, ready to receive subsequent toppings, coatings, or penetrating treatments. “L&M Cure” as manufactured by L&M Construction Chemicals, Inc. or equal.

2. Burlap with Polythene backing sheets shall conform to ASTM C171 Class 3 and shall consist of burlap weighing not less than 10 oz/lin. yard, 40 inches wide, impregnated on one side of white opaque polyethylene 6 mils thick.

3. Membrane-Forming Curing Compound shall be liquid type conforming to ASTM C 309, Type 1, clear, Type 1D with fugitive dye for interior work, and Type 2, white, pigmented for exterior work.

M. Vapor Barrier: Shall meet the requirements of ASTM D4397 and shall be at least 10 mils thick.

2.2 CONCRETE STRENGTH

A. Mixes shall be designed to secure concrete having the compressive strength required by the drawings or stated in these specifications. The water/cement ratio shall be consistent with the concrete strength requirements. Surface water contained in the aggregate shall be included as part of the mixing water. Consistency shall be designed for good workability and plasticity for proper placing.

B. The recommended cement content shall be adjusted to meet the maximum dry shrinkage of 0.04% at 28 days (ASTM C157). Shrinkage reducing admixture (SRA) shall be provided at no additional cost to the OWNER. The CONTRACTOR shall furnish the Independent Laboratory testing of Dry Shrinkage and Compressive Strength on mix designs with cement and aggregates from the same sources as evidence of the amount of dry shrinkage of the mix. If previous laboratory tests are not available on the mix designs proposed, then the Contractor shall hire an independent laboratory to conduct dry shrinkage and compressive tests, and the results shall be submitted with the mix design for approval by the ENGINEER. If trial mixes are used, make a set of at least 6 cylinders for compressive strength in accordance with ASTM C192 and 6 test specimens for shrinkage tests in accordance with ASTM C157. Test 3 cylinders for compressive strength and 3 test specimens for shrinkage at 7 days and three at 28 days. After approval of mixes, no substitution in material or changes in proportion will be allowed without additional testing. The water-to-cement ratio used for shrinkage testing shall not exceed the value listed in Paragraph C below. If the water-to-cement ratio for shrinkage testing is less than the value listed in Paragraph C, the shrinkage test water-to-cement ratio shall be the maximum value and replace the value listed in Paragraph C.

C. Concrete of the various mixes indicated and as required in all sections of these specifications or drawings shall be proportioned and mixed for the following requirements:

Mix Number	1	2	3	4
Minimum Compressive Strength at 28 Days	4000	4000	4000	3000
Recommended Minimum Cementitious Material Content*	As required by Design	As required by Design	600 lbs. per CY	
Maximum Water-Cement Ratio	0.45	0.45	0.50	0.53
Maximum Shrinkage at 28 days (%) (ASTM C157)	0.04	0.04	Not Applicable	Not Applicable
Portion of Structure	Alternate to Mix 2 for Slabs in contact w/water or fill	Slabs, piers, and walls in contact w/water, fill, or Slabs, Beams	Leveling slabs or topping	Footings & pipe encasement
Size of Coarse Aggregate	1-1/2”	3/4”	3/8” - #8	3/4”
Slump Maximum	+/- 2” of Design Recommendations	+/- 2” of Design Recommendations	4”	3”
Air Content†	6%± 1.5%	6% ± 1.5%	6-7 ½%	
* Note: Cement content shall be adjusted to meet the minimum compressive strength specified. † Air shall be eliminated from the mix for slabs on grade and building interior slabs not subject to freeze and thaw cycles.				

2.3 READY-MIXED CONCRETE

A. At the CONTRACTOR'S option, ready-mixed concrete may be used to meet the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C94.

B. Ready-mixed concrete shall not be allowed to stand in the truck more than one hour before placing in forms, including time in route.

C. Each batch of ready-mixed concrete delivered to the job site shall be accompanied by a certified weighmaster delivery ticket furnished to the ENGINEER in accordance with Paragraph 1.4 C, specified herein.

D. Water shall not be added at the job site unless authorized by the ENGINEER.

PART 3 -- EXECUTION

3.1 SUBGRADE PREPARATION

A. Subgrade shall be free from standing water, mud, and debris at the time of placing concrete.

B. The earth's surface shall be firm and damp.

C. When concrete is to be placed on highly pervious materials, which might allow flowing groundwater to damage fresh concrete, the contact surface shall be covered with a layer of asphalt-impregnated building paper or polyvinyl chloride sheeting prior to placement of the concrete.

3.2 PROPORTIONING AND MIXING

A. Proportioning of concrete mix shall conform to the requirements of Chapter 3 of ACI 301.

B. Mixing of concrete shall conform to the requirements of Chapter 7 of ACI 301.

C. **Slump:** Maximum slump shall be as specified in Paragraph 2.2C.

D. **Retempering:** Retempering of concrete or mortar which has partially hardened will not be permitted.

3.3 PLACING REINFORCEMENT

A. Steel shall be placed according to Section 03 20 00 and according to Section 5.5 of ACI 301, whichever is more rigid.

B. Immediately after delivery, reinforcing shall be sorted for size, shape, and length or by final usage. Store on racks clear of the ground and protect at all times from the weather.

C. The CONTRACTOR shall cooperate with the ENGINEER to permit inspection of reinforcement before concrete is placed. The CONTRACTOR shall notify the ENGINEER 24 hours in advance of any concrete pour.

D. Inspection by the ENGINEER does not relieve the CONTRACTOR of his responsibility to comply with the drawings and specifications. Pouring of the concrete signifies that the CONTRACTOR is satisfied with the placing of reinforcement, levels, and lines of forms, placement of sleeves and forms for holes, locations of accessories, etc.

3.4 VAPOR BARRIER

A. Except where membrane waterproofing is required, the interior concrete slab on grade shall be placed on a continuous vapor barrier.

1. Place 4 inches of fine granular fill over the vapor barrier as a blotter for the concrete slab.

2. Vapor barrier joints shall be lapped 6 inches and sealed with compatible waterproof pressure-sensitive tape.

3. Patch punctures and tears.

3.5 CONSTRUCTION JOINTS

A. Construction joints shall be made only at points shown in the drawings or approved by the ENGINEER. All such joints shall be reinforced as shown; joining faces shall be thoroughly cleaned, wetted, and slushed with neat Portland Cement paste immediately before the next pour.

3.6 EXPANSION JOINTS

A. Expansion joint material shall be flush with the finished floor elevation. Where floors are painted to be painted, the expansion joint material shall be covered with caulk.

3.7 PLACING OF CONCRETE

A. Placing of concrete shall conform to Chapter 8 of ACI 301.

B. Plant-mixed concrete shall not be allowed to stand in the truck more than one hour before placing in forms, including time in route.

C. Preparation:

1. Remove hardened concrete, wood chips, shavings, and other debris from forms.

2. Remove hardened concrete and foreign materials from the interior surfaces of mixing and conveying equipment.

3. Have forms and reinforcement inspected and approved by the resident Engineer before depositing concrete.

4. Provide runways for wheeling equipment to convey concrete to the point of deposit. Keep equipment on runways that are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.

D. Bonding: Before depositing new concrete on or against concrete that has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.

1. Preparing surface for applied topping:

(a) Remove laitance, mortar, oil, grease, paint, or other foreign material by sandblasting. Clean with vacuum-type equipment to remove sand and other loose material.

(b) Broom clean and keep the base slab wet for at least four hours before the topping is applied.

(c) Use a thin coat of one-part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.

E. Placing: For special requirements, see paragraphs HOT WEATHER and COLD WEATHER.

1. Do not place concrete when weather conditions prevent proper placement and consolidation, when concrete has attained its initial set, or has contained its water or cement content for more than 1 1/2 hours.

2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.

3. Do not drop concrete freely more than 10 feet for concrete containing the high-range water-reducing admixture (superplasticizer) or 5 feet for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk) attached to a suitable hopper.

4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 20 inches in thickness and space tremies such as to provide a minimum of lateral movement of concrete.

5. Continuously place concrete until an entire unit between construction joints is placed. The rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete after its initial set has taken place or after 45 minutes of elapsed time during concrete placement.

6. On the bottom of members with severe congestion of reinforcement, deposit a 1-inch layer of flowing concrete containing the specified high-range water-reducing admixture (superplasticizer). Successive concrete lifts may be a continuation of this concrete or concrete with a conventional slump.

7. Concrete on metal deck:

   (a) Concrete on metal deck shall be minimum thickness shown. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for the slab.

   (b) The Contractor shall become familiar with the deflection characteristics of the structural frame to include the proper amount of additional concrete due to beam/deck deflection.

3.8 COLD-WEATHER REQUIREMENTS

A. Curing of concrete shall conform to Chapter 12 of ACI 301 and to these specifications.

B. Concrete must be kept wet for at least five days. Any concrete subject to rapid drying from wind or sun shall be protected by canvas, straw, polyethylene, curing compound, or other approved methods for this period.

C. Floors or walks shall not be used for any purpose until curing is complete. The floor, when used, shall be kept clean of nails, sand, and all abrasive materials.

D. For cold weather work, the CONTRACTOR shall also follow recommendations ACI 306.1, The CONTRACTOR shall be familiar with these procedures and shall provide protection as outlined in ACI 306.1. From October 15 to April 15, the concrete shall be delivered to the site at a temperature not less than 60°F. The CONTRACTOR may request a variance on a daily basis if the expected low temperature for the day is to be above 32°F.

E. The CONTRACTOR shall maintain a daily log outlining the cold weather concreting protection methods used. A signed copy of these logs shall be submitted to the ENGINEER weekly. The log shall be a thorough, dated, daily diary giving clear reference to the structure, location, and quantity of each concrete pour. At a minimum, the following information, as outlined in ACI 306.1, shall be included in the diary:

   1. Date, time, and quantity of pour.

   2. Daily outside high temperature.

   3. Daily outside low temperature.

   4. Basic daily weather conditions, including wind conditions, cloud conditions, and precipitation.

   5. Concrete temperature in the truck at the time of delivery.

   6. Concrete temperature ranges throughout the entire pour at the end of the pour for on-grade placements with a sketch and the temperature of the concrete at the end of the pour for walls and columns.

7. Protection methods being utilized.
8. Period of protection and temperatures of the concrete at 12-hour intervals during this protection period
9. If shelters are utilized, interior air temperatures of the shelter at 12-hour intervals.
10. Precautions utilized to prevent the drying and carbonation of the concrete protected by shelters.
11. Relative humidity inside the shelters.
12. Method of gradual cooling of the concrete at the end of the protection period.
13. Preparation and protection of the subgrade, forms, reinforcing steel, etc., prior to placement of the concrete.

F. Ready-mix suppliers log outlining the methods of heating the materials used in the concrete mixture for each pour.

G. All admixtures used for cold weather concreting shall be submitted with the design mix data for approval. No calcium chloride accelerators will be allowed in the concrete.

3.9 HOT WEATHER PLACEMENT

A. Concrete temperature prior to placement shall not exceed 90° F.

B. Concrete shall not be placed when either the ambient temperature or concrete temperature exceeds 90°F unless the following precautions are taken:

1. Dampen subgrade, forms, and reinforcement prior to placement.
2. Dampen aggregates slightly if they are dry and absorptive.
3. Supply a concrete mix with set retarders meeting ASTM C 494 to ensure the concrete remains plastic until the completion of finishing operations.
4. Concrete shall not be retempered.
5. Minimize the total time between the commencement of concrete placement and the start of the curing process.
6. Apply white pigmented curing compound (ASTM C 309, Type 2) at the coverage rate recommended by the manufacturer.
7. Moist cure when curing compound has not been applied within 2 hours of concrete delivery or as soon after final finishing as practical.
8. Commence curing after the final steel troweling or when the surface is uniformly hardened past the “thumbprint hard” stage, with no free water at the surface.

C. Under no circumstances shall concrete be placed when either the ambient air temperature or concrete temperature reaches 95°F.

D. Concrete materials shall be kept as cool as possible by shading or evaporative cooling. To lower the temperature of the concrete mix, equal volumes of ice may be used to substitute for portions of the mixing water.

3.10 REMOVAL OF FORMS

A. Forms shall be removed without damaging the concrete. No loading will be permitted on green concrete. Members which must support their own weight shall not have their forms removed until

they have attained at least 75 percent of their 28-day strength of the concrete specified. Forms for all vertical walls and columns shall remain in place at least 48 hours after the concrete has been placed. Forms for all the work not specifically mentioned herein shall remain in place for periods of time as determined by the Engineer.

B. After removal of forms, concrete shall be cured as specified in Paragraph 3.18

3.11 CONCRETE FINISH

A. Finish on the sidewalk shall be troweled and broomed. The remaining finished concrete floors, tank bottoms, or stairs shall be a smooth trowel finish.

B. Steel trowel finishing shall be done in such a manner as to produce a dense, smooth, impervious surface, free of blemishes, waves, dips, humps, pockets, cat-faces, or trowel marks. Care shall be taken that no excess water is present when the finish is started. Troweling shall be delayed until the water sheen produced by floating is disappearing. Apply a curing compound immediately after troweling unless the concrete is being cured by wet curing, then cure as per the burlap manufacturer's recommendations. Finish painting shall be as specified in Section 09 91 00 - Wastewater Treatment Facility Painting.

C. Concrete floors and tank bottoms shall be finished monolithically with no special concrete or cement mortar topping for the finish. The slabs shall be brought to an even and true finish slightly above the elevations given in the drawings so that when properly consolidated and finished, the surface will be at the grades shown. Concrete shall then be tamped, straight-edged, floated, and finished as above.

3.12 FLOAT FINISH

A. A float finish shall be given to slab surfaces that receive trowel finish and other finishes as specified and to slab surfaces that are to be covered with membrane waterproofing, membrane roofing, or terrazzo.

B. After placing is completed, concrete shall not be worked further until ready for floating. Floating shall begin when the water has disappeared, when the concrete mix has stiffened sufficiently to permit proper operation of a power-driven float, or when both conditions have occurred. Any surface water remaining shall be removed before floating. The surface shall then be consolidated with power-driven floats. Hand floating shall be used in locations inaccessible to power-driven floats. The trueness of the surface shall be checked at this stage with a 10-foot 3000-millimeter straightedge.

C. Surface shall be plane to a tolerance not exceeding 1/4 inch in 10 when tested with a 10-foot straightedge placed on the surface at not less than two different angles. High spots shall be cut down, and low spots shall be filled. Surfaces shall be uniformly sloped to drains. Immediately after completion of leveling, the surface shall be refloated to a uniform, smooth, granular texture.

3.13 TROWEL FINISH

A. Finish shall be given to slab surfaces that are to be exposed to view and to slab surfaces to be covered with resilient flooring, paint, or other finish coating system. After completion of the float finish as specified above, the surface shall receive a trowel finish. First troweling after completion of float finish shall be done by a power-driven trowel and shall produce a smooth surface that is free of defects but may contain some trowel marks. Additional troweling shall be done by hand after the surface has hardened sufficiently. Final troweling shall be started when a ringing sound is produced as the trowel is moved over the surface. The surface shall be consolidated by hand troweling operation. The finished surface shall be free of trowel marks, uniform in texture and appearance, and plane to a tolerance not exceeding.

B. 1/4 inch in 10 feet when tested with a 10 feet straightedge placed on the surface in any direction. Surface defects of sufficient magnitude to show through floor covering shall be removed by grinding.

3.14 NON-SLIP BROOM FINISH

A. Immediately after completion of the trowel finish, the surface shall be slightly roughened by brooming with a fiber-bristle brush in a direction transverse to that of main traffic.

3.15 CONCRETE BLOCK BOND BEAMS

A. All concrete for concrete block bond beams shall conform to specifications on strength and mixes herein mentioned. All such units shall have concrete block facing units as scheduled, laid in place by a mason with masonry mortar in conventional 3/8" tooled joints, then have steel as required set in place, then filled with well-puddled concrete. All corners shall be sharp and undamaged, and units shall be carefully protected from damage until the completion of masonry work.

3.16 PATCHING DEFECTIVE CONCRETE WORK FOR CONCRETE WALLS

A. After removing forms, all concrete surfaces shall be inspected, and any poor joints, voids, stone pockets, all tie holes, and any other defective areas marked by the ENGINEER shall be patched.

B. Where necessary, defective areas shall be chipped away to a depth of not less than one inch with the edges perpendicular to the surface. The area to be patched and a space at least six inches wide entirely surrounding it shall be wetted to prevent the absorption of water from the patching mortar.

C. A grout of equal parts Portland cement and sand, with sufficient water to produce a brushing consistency, shall then be well brushed into the surface, followed immediately by the patching mortar.

D. Patching materials shall be of the same material and of approximately the same proportions used for the concrete, except that the coarse aggregate shall be omitted. The mortar shall not be richer than one-part cement to three parts sand. The amount of mixing water shall be as little as consistent with the requirements of handling and placing. The mortar shall be re-tempered without the addition of water by allowing it to stand for a period of one hour during which time it shall be mixed occasionally with a trowel to prevent setting.

E. The mortar shall be thoroughly compacted into place and screed off to leave the patch slightly higher than the surrounding surface. It shall then be left undisturbed for a period of one to two hours to permit initial shrinkage before being finally finished.

F. The patch shall be finished in such a manner as to match the adjoining surface. On exposed surfaces where unlined forms have been used, the final finish shall be obtained by striking off the surface with a straightedge spanning the patch and held parallel to the direction of the form marks.

G. All patches shall be cured as specified herein.

H. Tie holes left by the withdrawal of rods or the holes left by the removal of ends of ties shall be filled solid with mortar after first being thoroughly wetted. For holes passing entirely through the wall, a plunger-type grout gun shall be used to force the mortar through the wall, starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside, and when the hole is completely filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing entirely through the wall shall be filled with a small tool that will permit packing the hole solid with mortar. Any excess mortar at the surface of the wall shall be struck off flush with a cloth.

I. All concrete ridges and protrusions, such as those left by nail holes or insufficient joining of forms, shall be removed by hammering and grinding to the satisfaction of the ENGINEER. No grout wash shall be applied until ridges, protrusions, and other marks left by the forms have been removed to the satisfaction of the ENGINEER.

3.17 FINISH FOR CONCRETE WALLS

A. All concrete surfaces to receive paint or exposed above grade shall receive a grout finish. The CONTRACTOR shall verify with the painter if Grout Finish is an acceptable surface preparation method. Cleaning operations shall not be undertaken until all contiguous surfaces to be cleaned are completed and accessible. Grout shall consist of one-part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a mixture having the consistency of thick paint. White Portland Cement shall be substituted for a part of gray Portland cement to produce a color matching color of surrounding concrete as determined by a trial patch. The surface of the concrete shall be wetted sufficiently to prevent the absorption of water from the grout. Grout shall be uniformly applied with brushes or a spray gun. Immediately after applying grout, the surface shall be scrubbed vigorously with a cork float or stone to coat the surface and fill all air bubbles and holes. While grout is still plastic, all excess grout shall be removed by working surface with a rubber float, sack, or other means. After the surface whitens from drying (about thirty minutes at normal temperatures), it shall be rubbed vigorously with clean burlap. The surface shall be kept damp for at least 36 hours after the final rubbing.

B. Tie holes left by the withdrawal of rods or the holes left by the removal of ends of ties shall be filled solid with mortar after first being thoroughly wetted. For holes passing entirely through the wall, a plunger-type grout gun shall be used to force the mortar through the wall, starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside and when the hole is completely filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing entirely through the wall shall be filled with a small tool that will permit packing the hole solid with mortar. Any excess mortar at the surface of the wall shall be struck off flush with a cloth.

C. All concrete ridges and protrusions, such as left by nail holes or insufficient joining of forms, shall be removed by hammering and grinding to the satisfaction of the ENGINEER. No grout wash shall be applied until ridges, protrusions and other marks left by the forms have been removed to the satisfaction of the ENGINEER.

D. All interior tanks' surfaces under submerged services may be prepared as described in Section 09 91 00, 3.2 B, P14 in lieu of the above surface preparation.

3.18 CONCRETE CURING AND PROTECTION

A. General

1. Freshly placed concrete shall be protected from premature drying and cold or hot temperature and shall be maintained without drying at a relatively constant temperature for the period of time necessary for the hydration of cement and proper hardening of concrete. Initial curing shall start as soon as free water has disappeared from the surface of the concrete after placing and finishing. Concrete shall be kept moist for a minimum of 48 hours. Forms removed within seven (7) days after placement of concrete, the concrete surface shall be cured by one of the curing methods specified in Paragraph 3.18B below.

2. Final curing shall immediately follow initial curing and before the concrete has dried. Final curing shall continue until a cumulative number of hours or fraction thereof (not necessarily consecutive) during which the temperature of the air in contact with the concrete is above 50 degrees F 10 degrees C has totaled 168 hours. Alternatively, if tests are made of cylinders kept

adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 75 percent of the 28-day design compressive strength. Rapid drying at the end of the final curing period shall be prevented.

B. Curing Methods

1. Curing shall be accomplished by moist curing, moisture-retaining cover curing, membrane curing, and by combinations thereof, as specified.

2. Moist curing: Moisture curing shall be accomplished by any of the following methods:

   (a) Keeping the surface of concrete wet by covering it with water

   (b) Continuous water spraying

   (c) Covering the concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover.

   (d) Wet by water spraying or intermittent hosing. An absorptive cover shall be placed to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

3. Moisture-cover curing: Moisture-retaining cover curing shall be accomplished by covering.

   (a) Concrete surfaces with specified moisture-retaining cover for curing concrete. Cover shall be placed directly on concrete in the widest practical width, with sides and ends lapped at least 3 inches. Cover shall be weighted to prevent displacement; tears or holes appearing during the curing period shall be immediately repaired by patching with pressure-sensitive, waterproof tape or other approved methods.

4. Membrane curing:

   (a) Membrane curing shall be accomplished by applying a specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. The curing compound shall be applied uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. The second coat shall be applied in a direction at right angles to the direction of the first coat. Total coverage for two coats shall be not more than 200 square feet per gallon of curing compound. Concrete surfaces which are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by method and at the rate specified. Continuity of coating shall be maintained for the entire curing period, and damage to the coating during this period shall be repaired immediately.

   (b) Membrane-curing compounds shall not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

5. Curing Formed Surfaces

   (a) If forms are removed within seven (7) days of placement of concrete, then the concrete shall be cured by any of the curing methods specified.

   (b) Curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces shall be accomplished by moist curing with forms in place for full curing period (7 days) or until forms are removed. If forms are removed before seven (7) days, final curing of formed surfaces shall be accomplished by any of the curing methods specified above, as applicable.

6. Curing Unformed Surfaces

   (a) Initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, shall be accomplished by membrane curing. Unless otherwise specified, final curing of unformed surfaces shall be accomplished by any of curing methods specified above, as applicable final curing of concrete surfaces to receive liquid floor hardener of finish flooring shall be accomplished by moisture-retaining cover curing.

**** END OF SECTION ****

SECTION 03 41 13 - PRECAST HOLLOW CORE PLANKS

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. Roof planks.

B. Accessories.

1.2 RELATED REQUIREMENTS

A. Division 01 – General Requirements

B. Section 03 30 00 – Cast-in-Place Concrete

C. Section 04 20 00 – Unit Masonry Assemblies

D. Section 05 00 00 – Structural Metal

E. Section 05 50 00 – Miscellaneous Metal Work

1.3 REFERENCE STANDARDS

A. Reference the “Latest Edition” of all Standards unless noted otherwise.

B. ACI – American Concrete Institute International.

C. ACI 318 – Building Code Requirements for Structural Concrete.

D. AWS – American Welding Society.

E. ICC (IBC) – 2020 International Building Code.

F. PCI – Precast/Prestressed Concrete Institute.

G. PCI MNL-116 – Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

H. PCI MNL-135 – Tolerance Manual for Precast and Prestressed Concrete Construction.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate openings sizes and locations, attachment of related items, and other work related to the fabrication and installation of precast concrete units.

B. Sequencing: Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

C. Pre-Installation Meeting: Conduct a pre-installation meeting a minimum of two weeks prior to the installation of precast concrete. Require attendance of related trades and the Engineer. Review the following items:

1. Review shop drawings and installation details.

2. Anchor and weld plate locations.

3. Opening locations including those cut in the field.
4. Field cutting and core drilling limitations.
5. Site access requirements and obstructions including, but not limited to:
   (a) Access roads and maintenance thereof.
   (b) Protection and repair of existing paving.
   (c) Dewatering of footing trenches.
   (d) Job site snow removal.
   (e) Job site debris removal.
   (f) Overhead obstructions including power lines.
6. Cold weather grouting requirements and expectations.
7. Cleaning responsibilities and expectations.

1.5 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide precast concrete units and connections capable of withstanding design loads within limits and under conditions indicated in the drawings.
   1. Loading Requirements: As indicated in the drawings.
   2. Fire Resistance Ratings per 2020 International Building Code: As indicated in the drawings.

1.6 SUBMITTALS

A. See Section 01 33 00 – submittal procedures.

B. Shop Drawings: Include layout plans with unit locations, bearing and top of unit elevations, overall dimensions, building cross sections, details, and opening locations.
   1. Separately elevate and dimension each type of unit. Indicate the location of each unit on the overall layout by using the same identification mark placed on the actual unit.
   2. Indicate all cast-in openings 12 inches or larger in dimension. Label each opening as “cast-in”. Generally, note all other non-cast-in openings are to be cut in the field by related trades after approval by the precaster’s engineer.
   3. Indicate welded connections by AWS standard symbols and show the size, length, and type of each weld.
   4. Indicate locations of and detail hardware and anchorage devices to be cast-in to precast units with relationship to structure.
   5. Indicate locations of and detail hardware and anchorage devices to be embedded into or attached to the structure or other construction with relationship to structure.
   6. Schedule loose hardware and anchorage devices to be installed by others; include in schedule: identification marks, item descriptions, and total quantities.
   7. Indicate sections and details showing quantities and position of reinforcing steel and related items including special reinforcement.
   8. Indicate shim sizes and grouting sequence and cold weather grouting requirements.
   9. Handling procedures, sequence of erection, and bracing plan.

10. Comprehensive Engineering: Signed and sealed by a professional engineer responsible for its preparation who is registered in the state in which the project is located. Include all dead, live, and other applicable loads used in the design. Indicate loading on shop drawings.

C. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, notify the Engineer immediately and submit design calculations and drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials. Maintain the general design concept when altering the size of units and alignment.

D. Samples: Provide Owner/ Engineer with samples representing the finish color and texture of exposed surfaces when requested. Samples to be a minimum of 12 by 12 by 2 inches in size. Owner/ Engineer to verify finish meets or exceeds the expectation of the design intent.

E. Test Reports: At the request of the Owner/ Engineer provide test reports for concrete and other structural materials tested during fabrication including cement mill reports, mix reports, and cylinder break reports.

1.7 QUALITY ASSURANCE

A. Designer Qualifications: Precast concrete to be designed under the direct supervision of a Professional Structural Engineer licensed in the state where the project resides.

B. Fabricator Qualifications: A firm that specializes in manufacturing the types of precast concrete specified in good standing in the PCI Plant Certification Program, and that complies with the following requirements: No Exceptions. No other plant certification will be accepted.

1. Assumes responsibility for engineering precast concrete units and the building shell to comply with performance requirements. This responsibility includes the preparation of Shop Drawings and Comprehensive Engineering analysis by a qualified Professional Engineer.

2. Participates in PCI's Plant Certification program at the time of bidding and through the construction process.

3. Has sufficient production capacity to produce required units without delaying the Work.

4. Is registered with and approved by authorities having jurisdiction.

C. Erector Qualifications: PCI Certified, approved by the precast concrete manufacturer, and having a minimum of 5 years of experience in the erection of precast concrete similar to the requirements of this project. Erector's workman shall be properly trained to handle and erect precast units.

D. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook – Precast and Prestressed Concrete," applicable to types of structural precast concrete units indicated.

E. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."

1. Comply with camber and dimensional tolerances of PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction."

F. Welder Qualifications: AWS Certified, approved by the precast concrete manufacturer, and having a minimum of 5 years of experience in the erection of precast concrete similar to the requirements of this project. Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel"; and AWS D1.4, "Structural Welding Code – Reinforcing Steel."

G. Pollution Control Regulations: Comply with all pollution control regulations in fabricating and finishing all products. Protection of underground water and water runoff is the utmost priority.

1.8 DELIVERY, STORAGE, AND HANDLING

A. General Requirement: All lifting and handling, transportation and delivery, storage and support, and erection of precast panels to be performed by qualified personnel using methods and equipment approved by the manufacturer.

B. Identification: Label each unit with the date of production and mark indicating the unit location on the shop drawings.

C. Lifting and Handling: Lift and handle units at all times by lifting points indicated on the shop drawings. Lift with manufacturer-approved lifting devices. Lifting devices to have a minimum safety factor of 5 to 1.

D. Transportation and Delivery: Transport units in accordance with manufacturer requirements.

E. Storage and Support: At all times store and support units off ground with identification marks clearly visible so lifting devices are accessible and undamaged. Separate stacked units by batten across the full width of each bearing point. Do not use stacked precast units for storage of other units or equipment.

1.9 FIELD CONDITIONS

A. General Contractor shall prepare and maintain the site free of obstructions as required by the precast erector for the work of this section.

B. Cold Weather Grouting: Provide written procedures to address cold-weather grouting to the Owner/Engineer prior to the erection process.

1.10 WARRANTY

A. Provide a 12-month guarantee for workmanship, materials, and satisfactory performance from the date of Substantial Completion.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Precast Concrete:

1. Wells Concrete Products: www.wellsconcrete.com
2. Molin Concrete Products: www.molin.com
3. Taracon Precast: www.taraconprecast.com
4. Substitutions: See Section 01 60 00 – Materials, Equipment, Labor and Workmanship; including the following requirements:

(a) Manufacturer and plant must be PCI Certified. No Exceptions.

(b) Manufacturer must submit product information including typical details, proposed product construction, handling information, etc. for approval by Engineer.

(c) Manufacturer must obtain written approval of project Engineer prior to submitting a bid.

(d) Manufacturer must obtain written approval of General Contractor prior to submitting a bid.

2.2 PRECAST UNITS

A. Roof Planks.

1. Size/Shape/Profile: As indicated in the drawings.

2. Top: Suitable surface for the application of a fully-adhered roofing system.

3. Bottom: Grade A (PCI). Sack rubbed to provide a finish acceptable to the Engineer.

4. Concrete Color: Gray.

5. Provide batt insulation or foam core insulation inside the precast cores, 4-feet from the inside face of the wall, at all precast planks along the periphery of the building.

2.3 MATERIALS

A. All materials shall comply with the specifications, standards, and codes quoted herein. The Engineer upon request shall be furnished satisfactory certification that all material incorporated in the precast concrete products comply with the requirements herein specified.

B. Forms and Forming: Material and equipment that will provide a semi-smooth/anticipated finish with the understanding that common forming marks and bottom tearing will be evident. Review expectations with the Owner/ Engineer.

C. Portland Cement: ASTM C150 Type I or III: ASTM C150.

D. Portland Limestone Cement, ASTM C595 Type IL.

E. Other Cementitious Materials: Ground granulated blast furnace slag: ASTM C 989.

F. Admixtures:

1. Air entraining admixtures: ASTM C260.

2. Water reducing, retarding, accelerating admixtures: ASTM C494.

G. Aggregates: ASTM C33 except for coarse aggregates for precast concrete surfaces exposed to damp conditions shall contain zero iron oxides.

1. Lightweight aggregate for structural components: ASTM C330.

H. Water: Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

I. Reinforcing Steel: Reinforcing steel or mesh will be selected from the following materials to conform to the precaster's design unless otherwise indicated in the drawings. Reinforcing bars shall not be welded without the specific approval of the Engineer.

1. Bars:

(a) Deformed billet steel: ASTM A615.

(b) Deformed rail steel: ASTM A616.

(c) Deformed axle steel: ASTM A617.

(d) Deformed low-alloy steel: ASTM A706.

2. Wire: Cold drawn steel: ASTM A82.

J. Strand: Uncoated, 7-wire, Stress-Relieved Strand: ASTM A416-Grade 250K or 270K.

K. Anchors and Inserts:

1. Materials:

(a) Structural Steel: ASTM A36.

(1) Shop Primer: Manufacturer's standards.

a. Location: Items protected by sealants or finish coatings.

(2) Hot Dipped Galvanized: ASTM A153.

a. Location: Items left exposed unless otherwise indicated. Cold galvanize field welds.

(3) Zinc-rich Coating: MIL-P-2135, self-curing, one component, sacrificial.

a. Location: As indicated.

(4) Cadmium Coating (Electroplated).

a. Location: As indicated.

(b) Stainless Steel: ASTM A666, type 304.

(1) Location: As indicated.

L. Other Items Cast-In to Precast Units:

1. Items required for connections for building design.

2. Other Items: As indicated in the drawings.

3. Locations: As indicated in the drawings.

2.4 ACCESSORIES

A. Cement Grout: Type I (ASTM C150 / C150M), “Dry Pack”, Portland cement, sand, and water having a minimum of 3,000 psi compressive strength at 28 days. (Approximately 3 to 1 sand/cement ratio.)

B. Bearing Pads:

1. Unless noted otherwise on the plans, Elastomeric Bearing Pads conforming to Division 2, Section 25 of AASHTO Standard Specifications for Highway Bridges shall be used.

2. The PCI Design Handbook, Second Edition, Part 5.1 through Part 5.5 shall be used for the design of bearing pads.

3. Tetrafluoroethylene (TFE) reinforced with glass fibers and applied to stainless or structural steel plates.

C. Sealants:

1. Refer to Section 07 9200 - Joint Sealants; Precast to precast products.

2. Refer to Section 07 8400 – Firestopping; Installation to be performed by a licensed contractor (Not Precast Erector) in the area in which the project is located.

3. Tremco; Dymeric 240 FC: www.tremcosealants.com

4. BASF Sonneborn; Sonolastic NP2: www.buildingsystems.basf.com

5. Backer Rod: Denver Foam or equivalent. www.backerrod.com

6. Provide products compatible with adjacent work.

D. Welding Materials: Per AWS D1.1/D1.1M, “Structural Welding Code – Steel”; compatible with materials being welded.

E. Welded Studs: Per AWS D1.1/D1.1M, “Structural Welding Code – Steel”; compatible with materials being welded.

F. Anchor Bolts: As designed by the precast manufacturer, cast-in-place by others.

G. Other Load Bearing Loose Steel Items: As designed by the precast manufacturer.

2.5 FABRICATION

A. Pre-stress all precast units.

B. All reinforcing steel shall have minimum cover as required by code and shall be accurately located as indicated on the approved shop drawings. Metal chairs, with or without coatings, shall not be permitted in the finished face.

C. All of the fabrication procedures shall be carried out under a fully protective overhead and sidewall covering, with a constant temperature of between 50 and 80 F being maintained except during the curing cycle.

2.6 FABRICATION TOLERANCES

A. Fabricate units in accordance with MNL-116 and MNL-135 and as follows:

1. Length: Plus or minus 1/8 inch for every 10 feet in length or 1/2 inch, whichever is greater.

2. Width: Plus or minus 1/8 inch for items 48 inches or less; 1/4 inch for items 48 to 120 inches, and 1/2 inches maximum for items over 120 inches and more.

3. Cross Sectional Dimensions: Plus or minus 1/8 inch for items 48 inch or less; 1/4 inch for items 48 to 120 inches, and 1/2 inches maximum for items over 120 inches and more.

4. Cast-in Anchors and Inserts: Plus or minus 1 inch from the centerline location indicated on shop drawings.

5. Horizontal Alignment (Sweep): Plus or minus 1/3 inch for every 10 feet in length or 1/2 inch, whichever is greater.

6. Vertical Alignment (End Squareness): Plus or minus 1/8 inch for every 12 inches in height or 1/4 inch, whichever is greater.

7. Camber: Variation between units is plus or minus 1/4 inch for every 10 feet in length or 1/2 inch, whichever is greater.

8. Blockouts: Plus or minus 1 (can this be less) inch from the centerline location indicated on shop drawings.

2.7 CONCRETE MIXES

A. 28-day compressive strength: Minimum of 5,000 psi.

B. Use of calcium chloride, chloride ions, or other salts is not permitted.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify site is free of obstructions and ready to receive the work. Obstructions include but are not limited to dewatering of footing trenches, job site snow removal, site debris, and overhead obstructions, including power lines.

B. Verify access roads have been prepared to handle all weather conditions and are acceptable to the precast concrete installer.

C. Do not begin the work of this section unless preparations by the site contractor are complete and the site contractor understands and agrees to maintain acceptable conditions until precast installation is complete. Beginning the work of this section is acceptance of existing conditions.

3.2 PREPARATION

A. Preparation: General Contractor (Buyer) shall be responsible for the following items:

1. Removal of all obstructions including but not limited to power lines and wires that may be hazardous to precaster’s personnel and other items required for precast installation.

2. All-weather access roads for precaster's trucks and cranes. Refer to the precaster's proposal/quotation for more defined access requirements.

3. Grid locations, building corners, finish floor elevations, top of door elevations, and other survey points/lines/elevations for accurate installation of precast units.

4. True and level bearing surfaces on all field placed bearing walls and other field placed supporting units.

5. Placement and accurate alignment of anchor bolts, plates, or dowels in column footings, grade beams, and other field-placed supporting units.

6. All shoring is required for composite beams and slabs. Shoring shall have a minimum load factor of 1.5 x (dead load plus construction loads).

7. Repair all concrete and bituminous surfaces damaged during precast installation. Examine surfaces with the precaster before and after precast installation and coordinate efforts to minimize damage.

3.3 ERECTION

A. Precast Unit Curing Procedures: Contact precaster for other curing requirements.

B. Erection Shall Be Defined As:

1. Placing, aligning, and leveling the precast units in final positions in the structure on the designated supporting surfaces.

2. Connection of precast units to each other, or to supporting structural units as indicated on the shop drawings.

3. Removal of lifting hooks, if necessary.

4. Cleaning and sealing of “Precast” to “Precast” joints. Joints include:

(a) Precast to precast including joints between interior and exterior units.

(b) Precast to bearing.

5. Sealing of “Precast” to “Other Materials” and joints that require “Firestopping” are NOT considered part of erection unless indicated otherwise.

C. Field Welding: Complete field welding using qualified personnel, equipment, and welding materials that are compatible with the base material.

D. Grouting:

1. Grout plank keyways and cores in accordance with precaster’s shop drawings.

2. General Contractor Responsibility: General Contractor shall be responsible for providing “shelters/tarps” and “temp heat” for grouting when temperatures are below 40 degrees for a 24-hour period.

3.4 TOLERANCES

A. Erect precast units level, plumb, square, true, and in alignment without exceeding the non-cumulative erection tolerances of PCI MNL 135. Position units so that dimensional errors do not accumulate and so joints remain aligned and uniform as erection progresses. Level out variations between adjacent units by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Engineer.

B. In the event that precast units cannot be adjusted to conform to design or tolerance criteria, cease work and advise Engineer. Execute modifications as directed by the Engineer prior to resuming work.

3.5 SEALANT INSTALLATION

A. General Contractor/Owner shall coordinate with the precast erector sealing of precast joints where required. The general contractor accepts responsibility if the precast joints above the roof deck and below grade are not sealed due to poor coordination/site conditions. The precast erector shall accept responsibility if precast joints are not sealed but were coordinated in a timely fashion by the General Contractor/Owner.

B. Install backer rod and sealant according to product manufacturer’s instructions.

3.6 FIELD REPAIR AND CLEANING OF PRECAST UNITS

A. Repairs by Precast Erector: Repair chipping, spalling, cracking, and other damages to precast units after delivery to the job site. After installation and repairs are completed, all further damage is the responsibility of, and at the cost of, the General Contractor. Consult with precaster for repairs of structural precast units.

B. Cleaning by General Contractor: Clean exposed surfaces that are soiled during shipping, installation, and remaining construction operations, prior to Substantial Completion. Clean in accordance with precast manufacturer’s recommendations.

3.7 INSPECTION AND ACCEPTANCE

A. Final inspection and acceptance of erected precast/prestressed concrete shall be made by Engineer to verify conformance with plans and specifications.

3.8 PROTECTION

A. General Contractor to protect precast units from remaining construction operations.

**** END OF SECTION ****

SECTION 04 20 00 - UNIT MASONRY ASSEMBLIES

PART 1 -- GENERAL

1.1 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).

2. Decorative brick units.

B. See Division 05 “Metals” for furnishing steel lintels and shelf angles for unit masonry.

C. See Section 07 62 00 “Flashing And Sheet Metal Work” for furnishing manufactured reglets installed in masonry joints for metal flashing.

1.2 SUBMITTALS

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

B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, “Details and Detailing of Concrete Reinforcement.” Show elevations of reinforced walls.

C. Samples for each type and color of exposed masonry units and colored mortars.

D. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.

1. For masonry units include material test reports substantiating compliance with requirements.

E. Mix Designs: For each type of mortar. Include a description of the type and proportions of ingredients.

1.3 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1.4 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where the titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified on the construction documents.

2.2 COLORS, TEXTURES, AND PATTERNS

A. Exposed Masonry Units: As indicated on construction documents.

2.3 CONCRETE MASONRY UNITS (CMUS)

A. Shapes: Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength for exposed units.

C. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with a minimum average net-area compressive strength of 1900 psi (13.1 MPa).

2. Weight Classification: Normal weight.

3. Pattern and Texture for Decorative Units:

(a) As indicated on construction documents.

2.4 CONCRETE AND MASONRY LINTELS

A. General: Provide either concrete or masonry lintels, at the Contractor's option, complying with the requirements below.

B. Concrete Lintels: Precast units matching concrete masonry units and with reinforcing bars indicated or required to support loads indicated.

C. Masonry Lintels: Made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM 595 Type IL.

B. Hydrated Lime: ASTM C 207 Type S.

C. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce the required mortar color.

D. Aggregate for Grout: ASTM C 404.

E. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by the same manufacturer.

1. Products:

(a) Addiment Incorporated; Mortar Tite.

(b) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

(c) Master Builders, Inc.

F. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.

1. Wire Size for Side Rods: W1.7 or 0.148-inch (3.8-mm) diameter.

2. Wire Size for Cross Rods: W1.7 or 0.148-inch (3.8-mm) diameter.

3. Wire Size for Veneer Ties: W1.7 or 0.148-inch (3.8-mm) diameter.

4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.

5. Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

6. Multiwythe Masonry:

(a) Ladder-type with 1 side rod at each face shell of hollow masonry units more than 4 inches (100 mm) in width, plus 1 side rod at each wythe of masonry 4 inches (100 mm) or less in width.

(b) Tab type, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on the outside face.

2.7 TIES AND ANCHORS

A. Materials:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.

2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.

3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on the outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to the face of the veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Wire: Fabricate from 3/16-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to the plane of the wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel wire.

2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.

E. Adjustable Masonry-Veneer Anchors

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to the plane of the wall, for attachment over the sheathing to wood or metal studs, and as follows:

2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

(a) Anchor Section: Rib-stiffened, sheet metal plate with screw holes on top and bottom, and slotted holes for inserting wire tie.

(b) Fabricate sheet metal anchor sections from 0.067-inch- (1.7-mm-).thick, steel sheet, galvanized after fabrication.

(c) Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.

(d) Products:

(1) Heckmann Building Products Inc.; 315-D with 316.

(2) Hohmann & Barnard, Inc., Dur-O-Wal Division

(3) Wire-Bond

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Section 07 62 00 “Flashing And Sheet Metal Work”.

1. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into the wall and 1/2 inch (13 mm) out from the wall, with the outer edge bent down 30 degrees.

2. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into the wall and out to the exterior face of the wall. At the exterior face of the wall, bend the metal back on itself for 3/4 inch (19 mm) and down into a joint 3/8 inch (10 mm) to form a stop for the retaining sealant backer rod.

3. Metal Expansion-Joint Strips: Fabricate from stainless steel or copper to shapes indicated.

B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz/sq. ft. (1.5-kg/sq. m) copper sheet bonded with asphalt between 2 layers of glass-fiber cloth.

(a) Products:

(1) Advanced Building Products Inc.; Copper Fabric Flashing.

(2) AFCO Products Inc.; Copper Fabric.

(3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.

(4) Phoenix Building Products; Type FCC-Fabric Covered Copper.

(5) Polytite Manufacturing Corp.; Copper Fabric Flashing.

(6) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.

(7) York Manufacturing, Inc.; York Copper Fabric Flashing.

2. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inches (1.0 mm) thick.

(a) Products:

(1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.

(2) Firestone Building Products; FlashGuard.

(3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 “Flashing And Sheet Metal Work”.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer’s standard products or products recommended by flashing manufacturer.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from a styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406, and designed to fit standard sash block and to maintain lateral stability in the masonry wall.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use one of the following, unless otherwise indicated:

1. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches (9 by 38 by 89 mm) long.

2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than the depth of outer wythe, in color selected from manufacturer’s standard.

3. Cavity Drainage Material: Free-draining mesh; made from polyethylene strands.

(a) Products:

(1) Advanced Building Products Inc.

(2) Hohmann & Barnard, Inc., Dur-O-Wal Division.

(3) Heckmann Building Products Inc.

(4) Wire-Bond.

(5) Mortar Net USA, Ltd.

4. Wicking Material: Cotton or polyester rope, 1/4 to 3/8 inch (6 to 10 mm) in diameter, and in length that is required to produce 2-inches (50-mm) exposure on the exterior and 18 inches (450 mm) in the cavity between wythes.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains from new masonry without damaging the masonry. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers:

(a) Diedrich Technologies, Inc.

(b) EaCo Chem, Inc.

(c) ProSoCo, Inc.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

2. Limit cementitious materials in mortar for exterior masonry to Portland cement and lime.

3. Add cold-weather admixture (if used) at the same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 -- EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

C. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

D. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

3.2 LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in the items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

E. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including the starting course on footings.

4. With entire units, including areas under cells, fully bedded in the mortar at the starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.4 COMPOSITE MASONRY

A. Bond wythes of composite masonry together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space no more than 36 inches (915 mm) apart around the perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.

2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

(a) Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.

(b) Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.

B. Collar Joints: Solidly fill collar joints by parging the face of the first wythe that is laid and shoving units of other wythes into place.

C. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.

D. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at the juncture, bond walls together as follows:

1. Provide individual metal ties not more than 8 inches (203 mm) o.c.

2. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

3. Provide rigid metal anchors, not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.5 MASONRY JOINT REINFORCEMENT

A. General: Install in the mortar with a minimum cover of 5/8 inch (16 mm) on the exterior side of walls, and 1/2 inch (13 mm) elsewhere. Lap reinforcement is a minimum of 6 inches (150 mm).

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing & concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and seismic anchors through the sheathing to the wall framing and to concrete and masonry backup with metal fasteners of the type indicated. Use two fasteners.

2. Embed tie sections, connector sections, and continuous wire in masonry joints. Provide not less than 2 inches (50 mm) of air space between the back of the masonry veneer and face of sheathing.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

4. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 32 inches (813 mm) o.c. horizontally with not less than 1 anchor for each 3.5 sq. ft. (0.33 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around the perimeter.

3.7 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, and other obstructions to the downward flow of water in the wall, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within the mortar joint, place through-wall flashing on the sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing as recommended by the flashing manufacturer.

2. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into the masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

3. Install metal drip edges beneath flexible flashing at the exterior face of the wall. Stop flexible flashing 1/2 inch (13 mm) back from the outside face of the wall and adhere flexible flashing to the top of the metal drip edge.

4. Install metal flashing termination beneath flexible flashing at the exterior face of the wall. Stop flexible flashing 1/2 inch (13 mm) back from the outside face of the wall and adhere flexible flashing to the top of metal flashing termination.

C. Install weep holes in head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.

2. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.

3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

4. Trim wicking material used in weep holes flush with the outside face of the wall after the mortar has set.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:

B. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.

C. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.9 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After the mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.

2. Protect adjacent surfaces from contact with the cleaner.

3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

4. Clean brick by a bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer’s written instructions.

6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.10 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

2. Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

**** END OF SECTION ****

SECTION 05 00 00 - STRUCTURAL METAL

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The requirements of the General Conditions and the Special Provisions shall apply to the work under this section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 50 00 - Miscellaneous Metal Work

B. Section 09 91 00 - Wastewater Treatment Facility Painting

1.3 DEFINITION

A. **Structural Steel** - Structural steel for this project shall be as defined by the American Institute of Steel Construction in the Code of Practice, most current edition, and shall also include specific items identified in the drawings as “Structural Steel”.

1.4 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specifications:

1. Design, fabrication, and erection of structural steel shall be according to “Specifications for Structural Steel for Buildings” adopted July 7, 2016, and according to the “Code of Standard Practice for Steel Buildings and Bridges” most current edition, all by the American Institute of Steel Construction, 130 East Randolph Street, Suite 2000 Chicago, IL 60601-6204, referred to hereinafter as AISC.

2. Those steel surfaces and connections which will remain exposed and subject to normal view by pedestrians or occupants in the completed structure shall be designed, fabricated, and erected according to the AISC “Specification for Architecturally Exposed Structural Steel”, most current edition.

3. The details of all joints, the technique of welding employed, the appearance and quality of welds made, and the methods used in correcting defective work shall conform to the requirements of the AISC Specification listed above and of the “Code of Arc and Gas Welding in Building Construction” of the American Welding Society.

B. Commercial Standards:

ASTM A 36	Specification for structural steel
ASTM A 992	Specifications for structural steel
ASTM A 325	Specification for high-strength bolts for structural steel joints
ANSI/AWS D1.1	Structural Welding Codes - Steel.

1.5 QUALITY ASSURANCE

A. The shop and field welding of structural joints shall be done by personnel qualified according to the “Standard Qualification Procedure” of the American Welding Society.

1.6 CONTRACTOR SUBMITTALS

A. Contractor shall electronically submit shop drawings as described in Section 01 33 00 for all structural steel. All fabrication information for components, size and weight of members, type and location of shop and field connections, type, size, and extent of all welds, use welding symbols of the American Welding Society, and welding sequence when required shall be indicated.

PART 2 -- PRODUCTS

2.1 MATERIAL

A. Structural steel shall conform to ASTM A992 or ASTM A36 as indicated on the structural drawings. The steel shall be new, without rust or scale, and shall be full-length pieces with no built-up lengths, crops, or stubs permitted.

B. Bolts shall conform to ASTM A325, high-strength bolts, and shall be three-quarters of an inch in diameter unless otherwise indicated.

C. Filler metal for welding shall be in accordance with the following:

1. Welding electrodes for manual 64T shielded Metal-Arc welding shall conform to ASTM A233 or E70 series.

2. Bar electrodes for granular flux used in the submerged-arc process shall conform to Paragraph 1.17.3 of AISC Specifications for Structural Steel for Building.

D. Non-metallic, non-shrink grout shall be Master Flow 713 by Master Builders Company, or equal.

2.2 FABRICATION

A. Workmanship shall conform to best practice and be accomplished by skilled mechanics trained in their trade.

B. Steel members shall be punched and drilled for attachment of wood nailer and/or other materials as required by project conditions. Slotted holes shall be provided for steel requiring true alignment and for members which cross-building expansion joints.

C. Shop connections may be welded, riveted, or bolted. Welded and/or bolted field connections shall be provided as indicated in the drawings.

D. For lintels bearing on masonry, a minimum of 8 inches bearing length on each end shall be provided unless otherwise indicated.

2.3 SHOP PAINTING

A. Steel shall be thoroughly cleaned of all loose mill scale, rust spatter, slag or flux deposit, oil, dirt, and other foreign matter. One coat of shop paint shall be applied as specified above to all surfaces, except as follows:

1. Machined surfaces, surfaces that are to be encased in concrete, surfaces that are to receive sprayed-on fire-proofing, and edges and surface areas adjacent to field welds shall not be painted.

2. Parts and surfaces which will be inaccessible after assembly or erection other than those surfaces listed above shall have two coats of paint. A differentiating color for the second coat shall be used.

B. Surfaces must be dry when the paint is applied.

C. Machined or milled surfaces shall be protected from corrosion by a suitable coating.

D. Shop painting shall be compatible with the finish coating specified in Section 09 91 00.

PART 3 -- EXECUTION

3.1 INSPECTION

A. All materials and workmanship to be furnished under this section shall be subject to inspection in the mill, shop, and field by the Engineer, or by qualified inspectors retained by the OWNER.

B. Inspection will be conducted without expense to the Contractor; however, inspection shall not relieve the Contractor of his responsibility to furnish materials and workmanship in accordance with contract requirements.

3.2 ERECTION

A. Erection and welding shall conform to the standards listed in Paragraph 1.4 above. Field cutting of structural steel is not permitted without the express permission of the structural engineer for each instance.

B. Column base plates and leveling plates shall be set level to correct elevations and temporarily supported on wedges or shims of steel until the supported members have been plumbed and grouted solid under the entire bearing area with non-shrink grout as specified in Paragraph 2.1, Item D. Templates shall be furnished or constructed on the job as required for the proper setting of anchors and bearing plates. During the progress of the work, the Contractor shall make periodic checks to see that a proper set is maintained.

C. Framing shall be erected true and plumb. All work during the progress of erection shall be securely connected to resist all dead load, wind, and erection stress, including loads from erection equipment and its operation. The Contractor shall provide all necessary temporary bracing, leaving it in place as long as required for safety, then remove it at the proper time.

D. Vertical plumbness deviation for individual members shall not exceed one five-hundredth of the clear height of the member.

E. Immediately after erection, field connections, weld burns, and abraded surfaces shall be repainted. Loose and scaling paint shall be removed by scraping and wire brushing to sound metal spot prime as necessary. Paint shall not be applied when temperatures are below 50°F, or when surfaces are damp or frosted.

**** END OF SECTION ****

SECTION 05 05 19 – POST-INSTALLED CONCRETE ANCHORS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes: Drilled-in anchors for concrete.

B. Related Sections:

1. Section 01 30 00 - Submittals
2. Section 03 30 00 - Cast-in-Place Concrete
3. Section 03 41 10 - Precast Hollow Core Planks
4. Section 04 20 00 - Unit Masonry Assemblies
5. Section 05 00 00 - Structural Metal
6. Section 05 50 00 - Miscellaneous Metal Work
7. Section 05 52 00 - Handrails and Railings

1.2 SUBMITTALS

A. All submittals shall be in accordance with Section 01 33 00 “Submittals” and shall be made for products specified in this section.

1. Product specifications with recommended design values and physical characteristics for epoxy dowels and expansion anchors.
2. Samples: Representative lengths and diameters of each type of anchor are shown on the Drawings.
3. Quality Assurance Submittals:

(a) Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

(b) Certificates:

(1) ICC-ES Evaluation Reports.

(2) NSF Certification for Water Treatment Applications.

4. Manufacturer’s installation instructions.
5. Installer Qualifications & Procedures: Submit installer qualifications as stated in paragraph 1.3 A. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:

1. Drilled-in anchors shall be installed by a contractor with at least five years of experience performing similar installations.

B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the contractor on the project with the Engineer present. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:

1. hole drilling procedure
2. hole preparation & cleaning technique
3. adhesive injection technique & dispenser training/maintenance
4. rebar dowel preparation and installation
5. torquing

C. Certifications: Unless otherwise authorized by the Engineer, anchors shall have one of the following certifications:

1. ICC-ES Evaluation Report indicating conformance with current applicable ICC-ES Acceptance Criteria.
2. NSF certification for use in concrete for water treatment applications.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages bearing the label of the manufacturer.

B. Storage: Store anchors in accordance with manufacturer's recommendations.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Fasteners and Anchors:

1. Wedge Anchors: ASTM A510; or ASTM A108.
2. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.
3. Stainless Steel Nuts: ASTM F594.
4. Zinc Plating: ASTM B633.
5. Hot-Dip Galvanizing: ASTM A153.
6. Reinforcing Dowels: ASTM A615

2.2 DRILLED-IN ANCHORS

A. Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings conforming to ICC-ES AC01 or ICC-ES AC193. Type and size as indicated on Drawings.

1. As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

2. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
    (a) Hilti Kwik Bolt TZ2
    (b) Simpson Strong-Bolt 2
    (c) Engineer approved equal

B. Screw Anchors: Screw type. Pre-drilling of the hole requires a standard ANSI drill bit with the same diameter as the anchor and installing the anchor will be done with an impact wrench. Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings.
    1. As indicated on the Drawings, provide mechanically galvanized or stainless-steel anchors. Mechanically galvanized steel anchors shall meet ASTM B695, Class 55 specifications. Stainless steel anchors shall be AISI Type 316 stainless steel. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
    2. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
        (a) Hilti KH-EZ
        (b) Simpson Titen HD
        (c) Engineer approved equal

C. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instruction. Type and size as indicated on Drawings.
    1. As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
    2. Reinforcing dowels shall be A615 Grade 60.
    3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
        (a) Concrete Applications
            (1) Hilti HIT-HY 200
            (2) Simpson AT-3G
            (3) Simpson SET-3G
            (4) Engineer approved equal
        (b) Masonry Applications
            (1) Hilti HIT-HY 270
            (2) Simpson SET-XP
            (3) Engineer approved equal

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Drilled-In Anchors:

1. Drill holes with rotary impact hammer drills using carbide-tipped bits, hollow drill bit system, or core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.

   (a) Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.

   (b) Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

   (c) Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

   (d) Holes shall be cleaned and dry per manufacturer's instructions.

2. Perform anchor installation in strict accordance with manufacturer instructions.

3. Wedge Anchors: Protect threads from damage during anchor installation. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

4. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

5. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors.

6. ACI/CRSI Adhesive Anchor Installer Certification is required for all installers of adhesive anchors.

7. Adhesive anchors shall not be loaded until the adhesive has reached its specified strength in accordance with the manufacturer's instructions.

3.2 REPAIR OF DEFECTIVE WORK

A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet installation torque requirements shall be regarded as malfunctioning. Complete modifications to structural members to allow new anchor holes to be drilled in original concrete at no change in contract price. Submit plan to Engineer for review and approval prior to starting repair work.

3.3 FIELD QUALITY CONTROL

A. Testing: 25% of each type and size of drilled-in anchor shall be torque tested by the independent testing laboratory. Adhesive anchors shall not be torque tested unless otherwise directed by the Engineer. If more than 10% of the tested anchors fail to achieve the torque specified by the manufacturer, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.

   1. Torque shall be applied with a calibrated torque wrench.

B. Minimum anchor embedments shall be as shown on the Drawings.

**** END OF SECTION ****

SECTION 05 50 00 - MISCELLANEOUS METAL WORK

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. CONTRACTOR shall provide all hangers, rods, bars, plates, bolts, nuts, screws, anchors, sleeves, brackets, rivets, welds, lugs, accessories, etc., required to complete work of this section and join to work of others, and shall do all bracing, blocking, cutting, fitting, drilling, tapping, leadings, etc., required to complete work and join to work of others.

B. CONTRACTOR shall make all preparations for hardware to be applied to work of this section, including reinforcing, mortising, drilling, and tapping.

C. CONTRACTOR shall coordinate work with other suppliers and subcontractors; obtain their approved shop drawings where necessary, or obtain any necessary additional detailed information regarding mounting conditions or other aspects of related work.

D. Dimensions shall be verified in the field prior to fabrication.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 Cast-in-Place Concrete

B. Section 03 41 13 Precast Hollow Core Plank

C. Section 05 00 00 Structural Metal

D. Section 09 91 00 Wastewater Treatment Facility Painting

1.3 DEFINITION

A. **Miscellaneous Metal**: for this project, all other metal products not specified elsewhere and not included under the definition of structural steel in Section 05 00 00 shall be identified as Miscellaneous Metal.

1.4 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

Aluminum Assn. AA-M32	C22A41
AASHTO HS-20	Truck Loading
ASTM A36	Specification for Structural Steel
ASTM A48	Specification for Gray Iron Castings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
ASTM A563	Specification for Carbon and Alloy Steel Nuts
ASTM F593	Specification for stainless steel bolts, hex cap screws, and studs

ASTM F594	Specification for stainless steel nuts
ANSI/AWS D1.1	Structural Welding Code - Steel
NFPA 101	Life Safety Code
NAAMM	Metal Stairs Manual

1.5 QUALITY ASSURANCE

A. Unless otherwise specified, all work shall be performed in accordance with the published recommendation of the National Association of Architectural Metal Manufacturers (NAAMM).

1.6 CONTRACTOR SUBMITTALS

A. Shop drawings shall be submitted electronically as described in Section 01 33 00. Shop drawings shall show all work to be fabricated with all construction details shown in an appropriate scale, methods of attachment to other materials, finishes, dimensions, shop welds and grinding of welds, field assembly joints, etc. CONTRACTOR shall verify dimensions at the project site as required.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. In fabricating items that will be exposed to view, limit materials to those which are free from surface blemishes, pitting, rolled trade names, and roughness.

B. Comply with the following standards, as pertinent.

1. Steel plates, shapes, and bars: ASTM A36;
2. Steel plates to be bent or cold-formed: ASTM A283, Grade C;
3. Steel tubing (hot-formed, welded, or seamless): ASTM A501;
4. Steel bars and bar-size shapes: ASTM A306, Grade 65, or ASTM A36;
5. Cold-finished steel bars: ASTM A108;
6. Cold-rolled carbon steel sheets: ASTM A336;
7. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525;
8. Stainless steel sheets: AISI type 302 or 304, 24 gauge, with number 4 finish;
9. Gray iron castings: ASTM A48, Class 10;
10. Steel pipe: ASTM A53, Grade A, Schedule 40, black finish unless otherwise noted;
11. Concrete inserts: As specified in paragraph 2.7 of this section;
12. Grout: As specified in Section 03 30 00;
13. Aluminum channels: anodized U.S. Alloy 6061, T-6.

2.2 ALUMINUM STAIRS AND ALUMINUM SAFETY TREADS

A. **Aluminum Stairs:** Aluminum stairs shall be fabricated in accordance with the standard practice of the National Association of Ornamental Metal Manufacturers, and as shown.

B. **Safety Tread Nosings:** Safety stair tread nosings shall be provided on all stairs, and elsewhere where shown. The safety treads for poured concrete stairs shall be as shown and shall be of galvanized steel.

C. **Treads:** Aluminum double-lock tread by Reliance. IKG aluminum grating tread with Mebac nosing or equivalent.

2.3 ACCESS HATCHES

A. **General:** Access hatches shall be of the design, sizes, and types shown.

B. Pump manufacturer to verify hatch size and location in top slab for clearance of pumps positioned as shown in the drawings. Minimum clearance of 3-inches required. Access hatches shall be provided with safety gratings.

C. Door leaves a minimum 1/4-inch aluminum, diamond pattern, to withstand a live load of 300 pounds per square foot.

D. Channel frame of minimum 3-inch welded aluminum with anchor flange around the perimeter. The channel frame shall be embedded in the concrete with a minimum 6-inch cover. The overall dimension of the access hatch frame shall not exceed 3 ¾ inches beyond the clear opening on all four sides. Access hatches using angle frames will not be accepted.

E. Each door leaf is to be equipped with heavy-duty recessed hinges, totally enclosed spring or torsion bar operators as necessary for easy operation, a drop handle, and an automatic hold open arm with a release handle. Locate hold open arm release handle such that it can be easily operated without endangering personnel.

F. Maximum hatch opening force is not to exceed 15 pounds when applied perpendicularly to the hatch edge through any part of the hatch-operating arc.

G. Each door leaf is to be secured with a snap-lock with a removable handle and padlock hasp welded to each leaf and frame as specified in Section 09 91 00 - Wastewater Treatment Facility Painting.

H. Aluminum surfaces mill finished. Apply bituminous paint to the exterior of the frame in contact with concrete.

I. Mechanical Fasteners and Hardware: Series 304 stainless steel.

J. Approved Manufacturers: Halliday, Bilco, or equal.

2.4 SAFETY GRATING

A. The protective grating panel shall be 1-1/2 in. “I” bar aluminum grating with Safety Orange powder-coated finish. Grating shall be hinged and supplied with a positive latch to maintain the unit in an upright position. Grating shall have a 6-in. viewing area on each lateral unhinged side for visual observation and limited maintenance. Grating support ledges on 300 lbs. psf loaded access covers only shall incorporate nut rail with a minimum of four (4) stainless steel spring nuts. A padlock hasp for an owner-supplied padlock shall be provided.

2.5 BOLTS AND ANCHORS

A. **Standard Service Bolts (Not Buried or Submerged):** Except where otherwise shown or specified, all bolts, anchor bolts, and nuts shall be Type 304 stainless steel, as specified below.

B. **Buried or Submerged Bolts:** Unless other corrosion-resistant bolts are shown, all bolts, anchor bolts, and washers that are buried, submerged, or below the top of the wall inside any hydraulic structure shall be of Type 304 stainless steel, which meets the requirements of ASTM F 593 and F 594. Anchor rods shall have rolled threads.

C. **Adhesive Anchors:** Unless otherwise shown or specified, all drilled, concrete, or masonry anchors shall be adhesive anchors. No material substitutions will be considered unless accompanied by an ICBO report verifying strength and material equivalency.

1. Adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Epoxy systems shall be **Hilti HIT-HY 200, Simpson Strong-Tie AT-3G, or pre-approved equal.**

D. **Expanding-Type Anchors:** Wedge anchors, if shown or permitted, shall be stainless steel Hilti Kwik Bolt TZ2, Simpson Strong-Bolt 2, or pre-approved equal. Lead caulking anchors will not be permitted. Size shall be as shown. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded, buried or submerged anchors shall be stainless steel.

2.6 CORROSION PROTECTION

A. Unless otherwise shown, miscellaneous metal work of fabricated steel which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with Section 09 91 00 - Wastewater Treatment Facility Painting, and shall not be galvanized prior to coating. All other miscellaneous steel metal work shall be hot-dip galvanized after fabrication or painted as directed by the ENGINEER.

2.7 PROTECTIVE SHOP TREATMENT

A. Steel and iron surfaces shall be cleaned and free of all mill scale, rust, and foreign matter by wire brushing, scraping, sandblasting, or flame cleaning. Grease and oil shall be removed with solvent; dust and dirt shall be removed with an air blast or brush.

B. Painting shall be as specified in Section 09 91 00 - Wastewater Treatment Facility Painting.

PART 3 -- EXECUTION

3.1 WELDING

A. **Method:** All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing the same.

B. **Quality:** In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and control dimensions. Weld reinforcement shall be as specified by the AWS Code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.2 GALVANIZING

A. All structural steel plates, shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A-123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts, and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A-153. Field repairs to galvanizing shall be made using **"Galvinox," "Galvo-Weld," or equal**.

3.3 DRILLED ANCHORS

A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the specified 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its specified strength in accordance with the manufacturer's instructions.

**** END OF SECTION ****

SECTION 05 52 00 - HANDRAILS AND RAILINGS

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. Contractor shall furnish and install handrail systems as indicated.

B. All handrail systems shall be designed and installed in conformance with current OSHA and State Building Code standards.

C. Complete shop drawings of all components, certified by a professional structural engineer, shall be submitted.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 03 30 00 - Cast-in-Place Concrete

C. Section 05 50 00 - Miscellaneous Metal Work

D. Section 09 91 00 - Wastewater Treatment Facility Painting

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Government Standards

1. OSHA General Industry Occupational Safety and Health Standards (24 CFR 1910)

2. State Building Code

1.4 CONTRACTOR SUBMITTALS

A. **Shop Drawings**: Submit shop drawings that indicate components of handrails and railings as indicated in the drawings.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials**: Manufactured materials shall be delivered in original unbroken packages bearing the label of the manufacturer.

B. **Storage**: All materials shall be carefully stored in a manner that will prevent damage in an area that is protected from the elements.

PART 2 -- PRODUCTS

2.1 SYSTEM DESIGN AND STRUCTURAL PERFORMANCE

A. **Code Requirements**: All railings, guardrails, and handrails shall conform to the code requirements for IBC and state-approved OSHA.

2.2 ALUMINUM PIPE HANDRAILS

A. Posts and rails shall be 2” nominal diameter with posts spaced not more than 6 feet on center.

B. Handrail systems shall include 3/8 inch by 4-inch toe plates.

C. Handrail and horizontal rails shall be fabricated of 2” NPS Schedule 40 alloy 6061-T6 pipe. The vertical post shall be fabricated of 2” NPS Schedule 80 allow 6061-T6 pipe. Handrail and posts shall be of welded construction.

D. All fasteners and anchors shall be stainless steel or aluminum.

E. All railings and posts shall have a clear anodized finish. A smooth-as-cast finish is not acceptable. All welds shall be ground smooth.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Materials shall be plumb, square, level, and anchored securely.

B. Bituminous or epoxy paint shall be applied where aluminum is placed in contact with a dissimilar surface.

C. All mounting hardware shall be aluminum. Anchors shall be stainless steel and designed for supporting the rail system rated load.

D. Upon completion of installation, touch up field welds and other blemishes using manufacturer approved products.

**** END OF SECTION ****

SECTION 05 53 00 - GRATING

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install gratings as shown on the plans.

B. The gratings shall be either fiberglass-reinforced resin grating or aluminum alloy 6063-T6 grating.

C. The gratings shall comply with OSHA standards for walking and working surfaces.

D. The aluminum gratings shall be manufactured in accordance with the Metal Bar Grating Manual published by the National Association of Metal Manufacturers and Federal Specification RR-G-661D "Grating, Metal Bar Type".

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittals

B. Section 05 50 00 - Miscellaneous Metal Work

1.3 SUBMITTALS

A. The CONTRACTOR shall submit shop drawings indicating the dimensions, weight, material finish, and the rated loading for the grating.

1.4 DESIGN CRITERIA:

A. The design of gratings including connections shall be in accordance with governing building codes and standards as applicable.

B. Grating and planking shall support a uniform load of 200 pounds per square foot with a deflection not more than 1/4" or 1/240 span length, whichever is less.

PART 2 -- PRODUCTS

2.1 ALUMINUM GRATING

A. Grating shall be fabricated of aluminum I-shaped bars, alloy 6063-T6, with swaged cross bars spaced on 4" centers. Bearing bars shall be spaced on 1-3/16" centers. The top surface of bearing bars shall be striated to provide a non-slip surface.

B. Planking shall be extruded from aluminum alloy 6063-T6. The top surface shall have continuous striations for skid resistance.

C. Grating and planking shall support a uniform load of 100 pounds per square foot with a deflection of not more than 1/4" or 1/240 span length, whichever is less. Maximum fiber stress shall not exceed that allowed by the Aluminum Association. Minimum depth shall be 1-1/4".

D. Ends of cross bars are to be trimmed flush with the outside face of each outside bearing bar. On stock width panels with 3/16" main bars, each outside bearing bar shall be punched with "detent" holes to form a permanent lock. On stock width panels with 1/8" main bars, and all ripped panels, the outside bearing bars shall be permanently locked in place by welding flush to cross bars.

E. Install aluminum clamps or clips to anchor grating and planking to supports. A minimum of four fasteners is required per panel unless otherwise noted in the drawings. Clips shall not protrude above the top of the grating.

F. Cutouts for circular obstructions to be at least 2” larger in diameter than the obstruction. Cutouts for all piping 4” or less in diameter to be made in the field. All openings where more than four bearing bars are cut shall be banded with bars of the same depth as the bearing bars. The ends of all grating and planking panels shall be banded.

G. Shelf angles shall be anchored to concrete with stainless steel type 304 wedge bolts.

H. Aluminum surfaces in contact with concrete or dissimilar metals shall be protected with a coat of bituminous paint.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All grating and components shall be installed level.

B. All mounting hardware, clips, and accessories shall be stainless steel.

C. Bituminous or epoxy paint shall be applied where aluminum is placed in contact with a dissimilar surface as specified in Section 09 91 00 - Wastewater Treatment Facility Painting.

D. Grating shall be fastened to bearing bars with stainless steel clips and bolts for easy removal.

**** END OF SECTION ****

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 -- GENERAL

1.1 SUMMARY

A. Provide labor, material, facilities, and administration required to furnish and install all rough carpentry needed for a complete building.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 03 11 00 - Concrete Formwork

C. Section 07 21 00 - Building Insulation

D. Section 07 53 01 - Fully Adhered Membrane Roof System

E. Section 08 10 00 - Doors and Frames

F. Section 09 91 00 - Wastewater Treatment Facility Painting

1.3 REFERENCE STANDARDS

A. Commercial Standards

PS-1	Construction and Industrial Plywood
PS-20	American Softwood Lumber Standard
AWPA C1	AWPA Manual of Recommended Practice
NFPA	National Forest Products Association National Design Specification for Wood Construction

B. Federal Standards

Fed. Spec. FF-B-561C	Lag and Screw Bolts
Fed. Spec. FF-B-575C	Hexagon and Square Bolts
Fed. Spec. FF-B-584E(1)	Bolts, Finned Neck; Key Head; Machine; Ribbed Neck; Square Neck; Tee Head.
Fed. Spec. FF-B-588C(1)	Bolt, Toggle: And Expansion Sleeve, Screw.
Fed. Spec. FF-N-105B(3)	Nails, Brads, Staples, and Spikes; Wire, Cut, and Wrought.
Int. Amd. 4	
Fed. Spec. FF-N-836D(1)	Nut: Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding, and Single Ball Seat.
Fed. Spec. FF-S111D	Screw, Wood.
Fed. Spec. FF-S-1362	Stud, Plain, General Purpose.

1.4 QUALITY ASSURANCES

A. All lumber shall be reasonably dry, live, sound, commercially dried, and free of warps that cannot be corrected in anchoring and from other defects impairing durability or strength. All lumber shall be kiln-dried.

B. Furnish and install all rough hardware or other metal fastenings indicated or required for proper installation of Carpentry, Millwork, and other items noted. Nails, spikes, screws, bolts, etc., shall be of sizes and types required to rigidly secure members in place.

PART 2 -- PRODUCTS

2.1 MATERIALS AND GRADES

A. Studs, plates, blocking, and furring lumber shall be “construction grade” Douglas Fir, 545, not over 18% moisture content.

B. Grades shall conform to the specifications of the Association of Lumber Manufacturers producing materials specified.

C. All wood blocking at the roof perimeter and blocking for metal coping shall be pressure treated or Wolmanized.

D. All plywood shall be Douglas Fir, exterior grade, and pressure-treated or wolmanized.

E. Nails, Spikes, and Staples: galvanized for all locations. Size and type to suit the application.

F. Bolts, Nuts, Washers, Lags, Pins, and Screws: Medium carbon steel; sized to suit application galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations.

G. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and log bolt type for anchorage to solid masonry or concrete. Bolts or power activated type for anchorage to steel.

PART 3 -- EXECUTION

3.1 GENERAL

A. Install miscellaneous blocking, furring, nailing strips, framing, and sheathing.

B. Install members true, plumb, and level. Secure in place.

C. Space miscellaneous framing and furring at 24-inches on center unless noted otherwise.

D. Construct members of continuous pieces of the longest possible lengths.

3.2 FASTENERS AND FRAMING DEVICES

A. **Nailing:** Where nail spacing is not otherwise regulated by the Building Code, nails shall not be driven closer together than 1/2 their length unless driven in drilled holes, not driven closer to the edge of a member than 1/4 of their length. When necessary to prevent splitting, holes shall be drilled slightly smaller than nail diameters. The nails shall penetrate the second or farther member not less than 1/2 the nail length.

B. **Bolts and Nuts:** Malleable or cut-steel washers shall be provided under bolt heads and nuts except where bearing on steel plates or other steel attachments or where flat-head countersunk bolts are shown. Bolt holes shall be drilled 1/32-inch to 1/16-inch larger diameter than the bolts they are to

accommodate, and shall be bored true-to-line. Members shall be clamped together, and bolts shall be driven in place and nuts drawn up tightly. Bolts shall be drawn tight again immediately prior to enclosing with finish or, if left exposed, upon completion of other work. Holes at anchor bolts embedded in concrete may be 1/16-inch larger than the bolt diameter.

C. **Screws:** Lag and wood screws shall be screwed, not driven, into place. Holes to receive lag screws shall be bored first of the same diameter and depth as the shank, then continued to a depth equal to the length of the screw with a diameter equal to the base of the screw thread. Screws shall penetrate into the farther member at a distance equal to at least 7 times the diameter of the screw shank. Washers shall be installed under each lag screw head bearing on wood.

D. **Metal Framing Devices:** Metal framing devices shall be furnished and installed where shown. Nails for the framing devices shall be as furnished or recommended by the manufacturer of the anchor device. All nails shall be driven to their full depth at all holes in anchors. Bolt and lag fasteners shall be drawn tight.

**** END OF SECTION ****

SECTION 06 80 00 - FIBERGLASS BAFFLES AND WEIR PLATES

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The Contractor shall furnish and install fiberglass reinforced plastic scum baffles and weir plates where shown on the plans. Specific dimensions and details shall be as shown on the plans.

B. The Contractor shall submit shop drawings for fiberglass scum baffles and weir plates to the Engineer for review.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 46 43 21 - Clarifier Equipment

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Scum baffles and weir plates shall be constructed from fiberglass-reinforced polyester resin, matched-die molded to produce smooth, resin-rich surfaces, free of voids, porosity, exposed glass, cracks, or crazes. All edges shall be sealed in the mold.

B. Laminate shall have Type “C” (chemical) glass surfacing mat, 10 to 20 mils thick, with a silane finish and a styrene soluble binder, on both sides. The required thickness will be achieved using the appropriate number of plies of Type “E” (electrical borosilicate) glass mat with chrome or silane finish and a styrene soluble binder. Glass content of laminate will be 28 +/- 3% by weight. Resin fillers shall be 40 +/- 2% of the resin mixture. Final laminate thickness shall be within +/- 10% of the nominal specified thickness.

C. Scum baffles and weir plates shall be 1/4” nominal thickness and the color shall be aqua. “Scum baffles and weir plates shall be laid up with sufficient internal reinforcement to meet the installation requirements.”

D. The fiberglass laminate shall have the following minimum physical properties:

TEST PARAMETER	VALUE	TEST METHODS
Tensile Strength	14,000 psi	ASTM D638
Flexural Strength	25,000	ASTM D790
Flexural Modulus	1.0 x 106	ASTM D790
Barcol Hardness	15.0 minimum	ASTM D256 Barcol Impressor-Model GYZJ-934-1
Water Absorption, 24 hours.	Average 40	ASTM D570
Average Coefficient of Thermal	0.1%	
Expansion-Inch Per Inch Per degrees F.	15 x 10-6	

E. Procedure used in determining the above properties shall be in accordance with the ASTM Standards, Part 27, using the method designated above. Hardness tests shall be made on the resin-rich surfaces of the test samples. Test coupons shall be prepared in accordance with the appropriate ASTM test method.

F. Manufacturer shall maintain a continuous quality control program and, upon request, shall furnish to the Engineer certified results of the physical tests listed above.

G. Weir plates and scum baffle plates fabricated from 1/4” thick plate stock with cut edges or notches will not be acceptable.

H. The spacing for the 90-degree V-notch weir in the final clarifiers shall be a maximum of 12 inches on center. The minimum depth of each notch shall be 2-1/2 inches.

PART 3 -- EXECUTION

3.1 FIELD CUTTING

A. Field cutting of fiberglass items furnished under this specification will be allowed to only one closure section. The cut edge shall be sealed with polyester resin and catalyst to form a watertight seal.

**** END OF SECTION ****

SECTION 07 11 00 - DAMPPROOFING

PART 1 -- GENERAL

1.1 SUMMARY

A. Provide labor, material, facilities, and administration required to furnish and install all dampproofing for exterior below-grade walls and additional areas as shown on plans.

1.2 RELATED SECTIONS

A. Division 03 - Concrete

B. Division 04 - Masonry

C. Section 07 21 00 - Building Insulation

D. Division 09 - Finishes

1.3 REFERENCES

A. ASTM D 41 – Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 1994 (re-approved 2000).

B. ASTM D 449 – Standard Specification for Asphalt Used in Dampproofing and Waterproofing; 1989 (Reapproved 1999).

C. ASTM D 4586 – Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2000.

1.4 SUBMITTALS

A. See Section 01 33 00 – Submittals, for submittal procedures.

B. Product Data: Provide properties of primer, bitumen, and mastics.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. BASF Master Seal 614.

2.2 MATERIALS

A. Bitumen: ASTM D 449, Type I, asphalt. Volatile organic solids (VOS) shall not exceed 2.25 lbs. per gallon.

B. Primer: ASTM D 41, compatible with substrate.

C. Sealing Mastic: Asphalt roof cement, ASTM D 4586, Type I.

2.3 ACCESSORIES

A. Fabric Membrane: Manufacturer's standard fiberglass fabric for creating membrane.

B. Protection Board: Rigid insulation specified in Section 07 21 0 "Building Insulation".

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify substrate surfaces are durable and free of matter detrimental to adhesion or application of the dampproofing system.

C. Verify items that penetrate surfaces to receive dampproofing are securely installed.

3.2 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.

B. Clean and prepare surfaces to receive dampproofing in accordance with the manufacturer's instructions.

C. Do not apply dampproofing to surfaces unacceptable to the manufacturer.

D. Apply mastic to seal penetrations, small cracks, or minor honeycomb in the substrate.

3.3 APPLICATION

A. Prime surfaces in accordance with the manufacturer's instructions.

B. Apply bitumen by trowel.

C. Apply bitumen at a temperature limited by equiviscous temperature (EVT) plus or minus 25 degrees F; do not exceed finish-blowing temperature for four hours.

D. Apply bitumen in one coat, continuous and uniform, at a rate of 11-12.5 sq. ft. per gallon per coat at dense surface foundations.

E. Apply bitumen in two coats, continuous and uniform, at a rate of 11-12.5 sq. ft. per gallon per coat at porous surface foundations. Install fiberglass membrane between coats, overlapping edges a minimum of 3-inches.

F. Apply from 2-inches below finish grade elevation down to over the top of footings.

G. Seal items projecting through the dampproofing surface with mastic. Seal watertight.

H. Place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing.

I. Scribe and cut boards around projections, penetrations, and interruptions.

J. Backfill no sooner than 24-48 hours after application, but no longer than 7 days.

3.4 SCHEDULE

A. Cast-in-Place Concrete Foundation Walls: Dense surface application of 1 coat trowel applied mastic.

B. CMU Foundation Walls: Porous surface – membrane system application of 1 coat of trowel applied mastic, fiberglass membrane, and final coat of trowel-applied mastic.

C. Dampproofing will be required at the following locations:

1. Top of all concrete footings.

2. Exterior face of foundation walls, from concrete footings to grade lines.

D. Dampproofing of the exterior of concrete process tank walls will not be required.

3.5 BACKFILLING

A. Do not place backfill for at least 24 hours after application.

B. Backfill shall be placed no later than 7 days after application.

**** END OF SECTION ****

SECTION 07 21 00 - BUILDING INSULATION

PART 1 -- GENERAL

1.1 SUMMARY

A. Provide all labor, materials, and tools required to furnish and install building insulation as shown and specified.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Concrete

B. Section 04 20 00 - Masonry Assemblies

C. Section 04 20 00 - Concrete Unit Masonry

D. Section 06 10 00 - Carpentry

1.3 SUBMITTALS

A. Submit two 6” x 6” samples of each type and thickness of rigid insulation.

B. Manufacturer's certification that materials meet specification requirements.

1.4 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Deliver materials to the site in the manufacturer's original unopened packaging.

B. Store materials in an area protected from weather, moisture, open flame or sparks, and construction traffic.

C. Remove damaged materials from the site.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers shall show experience in the production of the products specified.

2.2 MATERIALS

A. Cavity wall insulation: Urethane or polyisocyanurate, rigid, ASTM C591, with a minimum density of 2.0 lbs. per cubic foot, minimum R-value at 75 F of 6.5 per inch, Grade 1, Class 2, two (2) inches thick, widths to fit wall anchor locations. Insulation shall be foil-faced, and all insulation joints shall be taped. Rigid insulation to meet the requirements of ASTM E96 - Moisture Vapor Transmission. The installed product must have a moisture vapor transmission value of less than one (1) perm.

B. Roof insulation shall be as specified in Section 07 53 00.

C. Loose-fill insulation: Non-combustible (ASTM E136), glass fiber, loose-fill insulation meeting requirements of ASTM C764, Type 1, Category 2. “Insul-Safe III Deep Cold Pak” as manufactured by CertainTeed Corporation or approved equal. Provide minimum “R” values as indicated in the drawings.

D. Expanded Polystyrene Board Tapered Insulation: One pound per cubic foot density (1 PCF). “RayLite” as manufactured by DiversiFoam Products or approved equal. R = 3.85 per inch minimum. Thicknesses and configuration shall be to achieve minimum “R” values as indicated in the drawings.

E. Perimeter insulation shall be extruded polystyrene insulation board meeting the requirements of ASTM C578-92 Type IV. The R-value shall be 5.0 per inch at 75°F. The minimum thickness shall be 2 1/2 inches. The insulation shall be Dow Styrofoam, Certifoam by DiversiFoam™ equal. Rigid insulation to meet the requirements of ASTM E96 - Moisture Vapor Transmission. The installed product must have a moisture vapor transmission value of less than one (1) perm

F. Sound Insulation: Faced and unfaced blanket insulation where indicated in Drawings. “THERMAFIBRE” sound attenuation blankets as manufactured by USG Corporation or approved equal.

G. Cavity Wall Insulation Sealing Tape: Sealing tape with acrylic adhesive. Model #8086 as manufactured by 3M Company or approved equal.

H. Masonry cores shall be filled with sprayed polyurethane foam insulation with the following performance characteristics. Insulation shall be CoreFill500TM as manufactured by Tailored Chemical Products or equal.

1. Fire-Resistance Ratings: Minimum four (4) hour fire resistance wall rating (ASTM E-119) for 8-inch and 12-inch concrete masonry units when used in standard two (2) hour rated CMUs.

2. Surface Burning Characteristics: Maximum flame spread, smoke developed, and fuel contributed of 0, 5, and 0, respectively.

3. Combustion Characteristics: Must be noncombustible, Class A building material.

4. Thermal Values: “R” Value of 4.91 per inch at 32 degrees F mean; ASTM C-177.

5. Sound Abatement: Minimum Sound Transmission Class (“STC”) rating of 53 and a minimum Outdoor-Indoor Transmission Class (“OITC”) rating of 44 for 8” wall assembly ASTM E90-90).

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Cavity wall insulation shall be installed where voids occur. All cavity wall insulation joints shall be taped to provide a vapor barrier.

B. Install perimeter insulation at the exterior face of all exterior foundation walls.

C. Staple all batt insulation to wood joists and studs with Kraft paper face to interior side of wall. Fill all voids to ensure ceilings and walls are totally insulated.

**** END OF SECTION ****

SECTION 07 27 00 - VAPOR BARRIER

PART 1 -- GENERAL

1.1 SUMMARY

A. Provide labor, material, facilities, and administration required to furnish and install all vapor barriers as shown and/or as specified.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Concrete

PART 2 -- PRODUCTS

2.1 UNDERSLAB VAPOR BARRIER

A. Underslab and wall vapor barrier will consist of 15-mil. sheet polyethylene meeting ASTM E-1745 Class A, B, and C. Water vapor permeance rating (ASTM E 96, Water Method) shall be 0.034 Perms or less.

B. Manufacturer

1. W.R. Meadows, Perminator
2. Stego Industries, LLC, Stego Wrap Class A
3. Raven Industries, Vapor Block
4. Viper Vapor Check II

2.2 AIR AND VAPOR BARRIER – CAVITY WALL CONSTRUCTION

A. Spray-on air and vapor barrier membrane, or equal roll-on applied product. Wet mil thickness shall be a minimum of 60 mils and cured thickness shall be at least 30 mils or the manufacturer's recommendations, whichever is greater.

1. Tremco, Exo Air 120.
2. W.R. Meadows, Air-Shield LSR.
3. W.R. Grace, Perm-A-Barrier.
4. R Guard VB (Vapor Barrier) by Prosoco.

PART 3 -- EXECUTION

3.1 INSTALLATION UNDERSLAB

A. The subgrade shall be leveled to a smooth uniform surface prior to placing the vapor barrier.

B. Place the vapor barrier just prior to placing the concrete.

C. The vapor barrier shall lie flat, free of creases, folds and perforations.

D. Lap all joints 6” and turn edges up 3” at all walls.

**** END OF SECTION ****

SECTION 07 53 01 - FULLY ADHERED MEMBRANE ROOF SYSTEM

PART 1 -- GENERAL

1.1 SUMMARY

A. Work specified in this section shall include all materials, labor, administration, and facilities required to furnish and install a roof system as shown on the plans and specified.

1.2 RELATED SECTIONS

A. Division 03 - Pre-Cast Concrete

B. Section 06 10 00 - Rough Carpentry

C. Section 07 62 00 - Flashing and Sheet Metal Work

1.3 QUALITY ASSURANCE

A. Submittals

1. Submit samples as requested by Engineer.

2. Manufacturer's written product information, installation instructions, and guarantee information.

3. Indicate seam locations, perimeter and penetration details, and plan of roof walkways.

4. All submittals must be on file at the Engineer's office before the roof system may be installed.

B. Certificates

1. Manufacturers to submit an independent test lab report stating compliance with specification requirements and have the report dated within the last six (6) months.

C. Contractor's Qualifications

1. The insulation and roof membrane shall only be applied in strict compliance with the manufacturer's written instruction by a factory-trained and approved roofing contractor familiar with the product.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and base flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and flashings to remain watertight.

1. Accelerated Weathering: Roofing membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.

2. Impact Resistance: Roofing membrane to resist impact damage when tested in accordance with ASTM D3746/D3746M, ASTM D4272/D4272M, or the Resistance to Foot Traffic Test in FM Approvals 4470.

B. Material Compatibility: Roofing system materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to comply with Section 1504 in the current Minnesota Building Code. Meet Risk Category III wind loads.

D. Exterior Fire-Test Exposure: Class A; for application and roof slopes indicated; when tested by a qualified testing agency in accordance with ASTM E108 or UL 790.

1. Identify products with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Make no deliveries to the project until ready to install or approved storage is provided.

B. Deliver materials to project site in manufacturer's original unopened packaging and rolls.

C. Identify contents, manufacturer, brand name, thermal values, and applicable standards.

D. Store materials in areas protected from weather, moisture, open flame, or sparks, and according to the manufacturer's written instructions and codes.

E. Handle materials to prevent damage and remove damaged materials from the site.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install roof system during rain or wet weather or when surfaces are wet.

B. Do not apply the roof system when the air temperature is below the manufacturer's recommendations.

1.7 GUARANTEES

A. Provide Roofer-Contractor joint standard written weathertightness guarantee.

B. Provide roof insulation and membrane manufacturer's combined fifteen (15) years of written guarantee covering replacement of roof insulation and membrane from defects in materials and installation up to the original cost of installation.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Roof Membrane Manufacturers

1. Carlisle membrane
2. Elevate membrane
3. Johns-Manville membrane
4. Versico

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING **(EPDM-1)**

A. Ethylene Propylene Diene Terpolymer (EPDM) Systems meeting the following requirements are acceptable:

Physical Properties	Test Method	Specification
(Metric-SI Units)		
Color		Black
Specific Gravity	ASTM D297	1.15 +/- .03
Tensile Strength	ASTM D412	1300 psi (90 MPa) Min.
Elongation	ASTM D412	300% Min.
Tear Resistance, Die C	ASTM D624	150 lbs/in Min. (26.3 KN/m)
Shore A Hardness (5 Second Reading)	ASTM D2240	60 +/- 10
Ozone Resistance	ASTM D1149 7 days/100 pphm/104°F (40°C)/50%	No Cracks
Heat Aging (Accelerated)	ASTM D5737 days/240°F (116°C)	Ten. Min. 1200 psi (8.3 MPa) Elong. Min. 200%
Brittleness Temp.	ASTM D746	-49°F (-45°C)
Permeability, Water Vapor	ASTM E96 Proc. BW	2.0 Perm-Mils
Minimum thickness of the roof membrane is to be 0.060”.		
Minimum thickness of the roof membrane flashing is to be 0.060”.		

B. Provide metal attachments and anchorage compatible with the roof membrane.

C. Provide Bonding Adhesives, Splicing Cement, Lap Sealants, and Caulking products compatible with the roof membrane.

D. Pipe flashing and other accessories shall meet manufacturer's standard materials requirements for complete roofing system.

E. Nailers, Blocking: No. 2 or better, S4S, Douglas Fir-Larch, preservative-treated in AWPA “LP02 Pressure Treated with Water-Borne Preservatives.”

F. Flashing Material: The Manufacturer's standard system is compatible with a flexible sheet.

G. Fasteners: Corrosion-resistant of type, length, and strength required for the material to be fastened and as approved by the roofing manufacturer for the specific application.

2.3 COVER BOARD

A. General: Cover board as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.

B. Fiber-Reinforced Gypsum Roof Board: ASTM C1177/C1177M, glass-mat, water-resistant substrate, or ASTM C1278/C1278M, fiber-reinforced, water-resistant gypsum board.

1. Thickness: 5/8 inch.

2. Manufacturers: Subject to compliance with the requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

(a) Georgia-Pacific Gypsum LLC., "DensDeck Prime".

(b) National Gypsum Company, "DEXcell".

(c) USG Corporation, "Securock".

3. Surface Finish: Unprimed. If DensDeck cover board is used, the surface should be primed.

C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended in writing by roofing system manufacturer for application.

2.4 ROOFING INSULATION

A. Polyisocyanurate conforming to federal specifications ASTM C591. The minimum R-value at 75°F (ASTM C236) shall be not less than 10.0 for a nominal thickness of 1.5 inches. The minimum foam core density shall be 1.5 lb/cu ft. The total thickness shall be as shown in drawings and at a minimum shall be at least 3.0 inches.

1. Total R-Value: Minimum 30

B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.

2. Minimum Thickness: 1/4 inch.

3. Slope:

(a) Roof Field: As indicated on Drawings.

(b) Saddles and Crickets: ½ inch per food unless otherwise indicated on Drawings.

2.5 VAPOR BARRIER

A. Vapor barrier shall be installed in all areas with high interior humidity. The vapor barrier shall consist of two (2) ply fiberglass felt impregnated with asphalt or as recommended by the roof membrane manufacturer.

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

1. Size: Approximately 60 inches wide unless noted otherwise on drawings.

2. Color: Contrasting with roof membrane.

PART 3 -- EXECUTION

3.1 INSPECTION OF SURFACES

A. Verify that work of other trades which penetrate the roof deck or require workers and equipment to traverse the roof deck has been completed.

B. Examine surfaces for inadequate anchorage, foreign material, moisture, and unevenness which would prevent the execution and quality of application of the roofing system as specified.

C. Examine roof edge and curb lumber for proper anchorage.

D. Do not proceed with the application of the roofing system until defects are corrected.

E. Clear deck or dust, dirt, debris, ice, snow, etc., and promptly repair any disfigurement.

F. Placement of insulation constitutes acceptable roof insulation.

3.2 DISTRIBUTION OF STORED MATERIALS

A. Distribute temporarily stored materials evenly over the roof deck to avoid overloading.

3.3 INSTALLATION OF INSULATION ON ROOF

A. Loosely lay insulation boardstock over the roof deck in two layers with the joints staggered one-half width and length of the board below.

B. Neatly cut to fit insulation around roof openings and projections.

C. Lay no more insulation than can be covered by roofing membrane on the same day.

D. Leave surface clear of debris, ready to receive roofing.

3.4 INSTALLATION OF ROOF MEMBRANE

A. Verify all construction details with the factory representative prior to beginning installation.

B. Factory representative shall visit the site during application.

C. Install all materials according to the manufacturer’s written instructions.

D. Attach membrane to the roof deck with adhesive.

E. Install roof membrane according to the roof manufacturer's instructions and details.

F. Complete the sealing of all species by the end of each workday.

G. Install EPDM flashing and counterflashing as shown in the drawings and as recommended by the membrane manufacturer.

H. All EPDM flashing shall be installed on a daily basis.

3.5 NAILERS, BLOCKING

A. Install batten strips at the base of roof projections, penetrations, and non-roof edge perimeters per manufacturer’s details.

B. Treated wood nailers installed at roof perimeters, at the base of roof projections, and around specified roof penetrations shall be as follows:

Nailer shall be firmly fastened to the deck, wall, or existing structurally sound and secured nailers, so as to resist a force of 200 pounds per lineal foot in any direction.

1. The nailer shall be tapered (as required) so that it will always be flush at the point of contact with the membrane in either vertical or horizontal applications.

3.6 CLEANING

A. During the course of work, inspect surrounding grounds for debris and trash. Remove at end of each day's work.

B. Upon completion, leave roof areas and surrounding ground clean of debris, and trash.

3.7 FIELD QUALITY CONTROL

A. Upon completion of the system, a manufacturer's authorized representative will make a thorough examination of the installation to determine that the roof system has been applied according to the manufacturer's standards and these specifications.

3.8 TESTING

A. Testing may be carried out by flooding the entire roof or in sections. The roof or the sections shall be flooded to a minimum water depth of 2 inches. Scuppers and overflow openings may be temporarily blocked during flooding operations.

B. Areas where leaks are observed shall be thoroughly dried, repaired, and retested.

3.9 PROTECTION OF PARTIALLY COMPLETED ROOF

A. Temporary enclosure shall be constructed to prevent moisture from entering under the roof system. Use only the materials and methods recommended by the manufacturer.

3.10 WARRANTY INSPECTION

A. Before the expiration of the manufacturer's warranty period, the manufacturer or his authorized representative shall meet with the OWNERS representative for a final inspection. At this time defects and deficiencies in roofing and flashing shall be repaired at no additional cost. Warranty shall be in effect until final inspection and necessary repairs have been performed.

*** END OF SECTION ***

SECTION 07 62 00 - FLASHING AND SHEET METAL WORK

PART 1 -- GENERAL

1.1 SUMMARY

A. Work covered in this section shall include all material, labor, facilities, and administration required to furnish and install all sheet metal work shown or specified.

1.2 RELATED SECTIONS

A. Section 07 53 01 - Fully Adhered Membrane Roof System

B. Section 07 90 00 - Caulking and Sealants

1.3 SUBMITTALS

A. Shop drawings shall be submitted for copings, facia, and rainwater drainage. Joint details and locations shall be shown in the shop drawings.

B. Submit the manufacturer’s current specification and related literature.

C. Provide samples and a color chart for color selection.

D. Submit manufacturer’s 20-year paint warranty covering finish fade, chalk, and peel.

1.4 QUALITY ASSURANCE

A. Comply with Architectural Sheet Metal Manual, Sheet Metal and Air Conditioning Contractor's National Association, Inc., recommendations.

B. Fabrication and installation are to be completed by trained personnel.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Make no deliveries to the project until ready to install or approved storage is provided.

B. All products to be stored above the ground on supports that are not to be used in the work.

C. Flammable materials must be stored in conformance with fire codes and in a manner that will not create a potential fire hazard.

D. Select and operate material handling equipment so as not to damage the existing construction or new roofing system, and without overloading the building structural system.

E. Any damage to existing construction must be immediately reported to the Engineer.

F. Color-coated sheet metal must be stored in a manner that will protect it from exposure to the sun up until the time of installation.

1.6 GUARANTEES

A. Provide manufacturer's standard twenty (20) year written guarantee for color-coated metal covering color fade, chalk, and film integrity.

PART 2 -- PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings and copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METAL MATERIALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, **G90** coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, **Class AZ50** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

1. Nominal Thickness: 24 Gauge
2. Surface: Smooth, flat.
3. Coil-Coated Finish:
    a. Pre-painted, galvanized steel (ASTM A526) with a minimum of 1 mil (dry) total thickness factory applied finish on the exposed and 0.3 to 0.4 mil (dry) total thickness factory applied finish on the unexposed surface.
4. Color: As selected by Architect from manufacturer's full range.
5. Manufacturers:
    a. Ryerson Building Products (“Colorklad”)
    b. Peterson Aluminum Corporation (“PAC-CLAD”)
    c. Firestone Building Products (UNA- CLAD)

C. Stainless Steel Sheet: ASTM A240/A240M, Type 316, dead soft, fully annealed.

1. Nominal Thickness: 20 Gauge.
2. Surface: Smooth, flat.

3. Exterior Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).
    a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
        (1) Run grain of directional finishes with long dimension of each piece.
        (2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.3 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
    1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
        a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
        b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
        c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
    2. Fasteners shall be of same material as flashing on which they are used and shall be of type and size shown on Drawings or specified herein unless noted otherwise.
    3. Fasteners exposed to the weather shall have EPDM washers under heads to ensure watertightness.
        a. EPDM bonded washers: Fabco Fastening System Weath-R-Seal Bonded Washers
    4. Sheet metal to wood:
        a. Where exposed: No. 8 minimum size steel hex head screw, 1-1/2" long. Minimum 150 lbs. per screw installed withdrawal resistance.
        b. Where not exposed: Minimum #14 flat head wood screw.
    5. Sheet metal to sheet metal: Self-tapping screws of 1/2" length and a minimum #3 diameter.
    6. Sheet metal to concrete or masonry: Tapcon or Gripcon, specially threaded anchors, 1/4" minimum diameter, length to penetrate masonry minimum one inch. Minimum 300 lb. per anchor installed withdrawal resistance.

C. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight. Color to match adjacent surface. Primer as recommended by sealant manufacturer.

2.4 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.

4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.

5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of **1/4 inch in 20 ft.** on slope and location lines indicated on Drawings and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.

2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with butyl sealant concealed within joints.

2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, non-expansion-type joints are required, form metal in accordance with the cited sheet metal standard to provide for the proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

H. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: **(SMF-10)**

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.

2. Fabricate in minimum **96-inch-** long sections.

3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.

4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

5. Gutter Profile: Style A in accordance with cited sheet metal standard.

6. Expansion Joints: Butt type with cover plate.

7. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.

8. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:

   a. Galvanized Steel: 20 Gauge, minimum thickness.

B. Downspouts: **(SMF-11)** Fabricate open-face downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: Internal support brackets.

2. Fabricate from the following materials:

   a. Galvanized Steel: 20 Gauge, minimum thickness.

2.6 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

2. Coordinate installation of equipment support flashing with installation of roofing and equipment.

3. Weld or seal flashing with elastomeric sealant to equipment support member.

PART 3 -- EXECUTION

3.1 FABRICATION

A. Shop form sections as much as possible.

B. Comply with Architectural Sheet Metal Manual, Sheet Metal and Air Conditioning Contractor's National Association, Inc.

3.2 INSTALLATION OF ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with joints sealed with sealant.

2. Provide for thermal expansion.

3. Attach gutters at eave or fascia to firmly anchor them in position.

4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Fasten gutter spacers to front and back of gutter.
7. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
8. Anchor gutter with brackets spaced not more than 24 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding 50 ft apart. Install expansion-joint caps.

C. Downspouts:
1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches in direction of water flow.

3.3 SCHEDULE

A. Provide reglets and other items installed by others in time to be built into the work.

3.4 INSPECTION

A. Verify that substrates are smooth and clean to the extent needed for sheet metal work.

B. Verify that reglets, cants, and blocking to receive sheet metal are installed and free of concrete and soil.

C. Do not start sheet metal work until conditions are satisfactory.

3.5 PREPARATION

A. Before installing sheet metal, verify the shapes and dimensions of the surface to be covered.

3.6 INSTALLATION

A. Install flashing and sheet metal to comply with Architectural Sheet Metal Manual, Sheet Metal and Air Conditioning Contractor's National Association, Inc.

3.7 REPAIRING

A. Repair or replace damaged work.

3.8 CLEANING

A. Leave work clean and free of stains, scrap, and debris.

**** END OF SECTION ****

SECTION 07 90 00 - CAULKING AND SEALANTS

PART 1 -- GENERAL

1.1 SUMMARY

A. Work specified in this section shall include all materials, labor, administration, and facilities required to furnish and install caulking and sealants as shown and specified.

B. Minimum Caulking Schedule

1. Caulking under this section shall include cleaning out openings and providing caulking at the following points:

(a) Caulking of every description shown on drawings and/or otherwise detailed.

(b) Caulking at joints at the juncture of hollow metal frames and exposed masonry on both sides of the wall at doors, windows, and louver frames.

(c) Caulking at exposed joints between wood and masonry interior and exterior expansion joints.

(d) Caulking at the face of interior and exterior, vertical and horizontal contraction joints.

(e) Caulking at joints between walls and pre-cast roof, floor slabs, floor planks, and at the penetration of floors, walls, and roof. Fire-rated caulk where required.

(f) Caulking at exposed joints in pre-cast roof and floor planks.

(g) Roof flashing and counter flashing.

2. Additional caulking may be specified under related sections.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete

B. Section 03 41 13 - Precast Hollow Core Planks

C. Section 04 20 00 - Unit Masonry Assemblies

D. Section 07 62 00 - Flashing and Sheet Metal Work

E. Section 08 10 00 - Doors and Frames

F. Section 09 91 00 - Wastewater Treatment Facility Painting

1.3 SUBMITTALS

A. Color charts and samples as requested.

B. Submit the manufacturer’s recommended installation instructions.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer’s original unopened containers with identifying labels intact and legible.

B. Store materials in areas protected from weather, freezing, and construction traffic.

1.5 GUARANTEE

A. The supplier shall replace any product found defective at no charge.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Tremco, Inc.

B. Sonneborn

C. Pecora

D. Sika Corporation

E. Dow Corning

2.2 SEALANTS

A. One-Component Acrylic Sealant:

1. Acrylic emulsion sealant, one-part, mildew resistant and paintable, complying with ASTM C834, recommended by the manufacturer for general use as an exposed building construction sealant, Pecora AC-20, or approved substitute.

B. Interior Silicone Rubber Sealant:

1. Silicone rubber-based, one-part elastomeric sealant, complying with ASTM C920, Type S, Class 25, Grade NS.

2. Use acid-type for non-porous joint surfaces and non-acid type where one or both joint surfaces are porous.

3. For wet areas, use type compounded specifically for mildew resistance.

4. Use for interior joints between equipment or counters and walls.

C. Two-Component Polyurethane Sealant:

1. Polyurethane-based, 2-part elastomeric sealant, complying with ASTM C920, Type M, Class 25, Grade NS (non-sag), Tremco “Dymeric”, Pecora “Dynatrol II”.

2. Optional Sealant: Contractor may, at his option, provide 1-Component Silicone Sealant, “Silpruf” by General Electric or #790 by Dow-Corning in lieu of above.

3. For exterior and interior walls, exterior wall joints, and floor joints, polyurethane as above except Grade P (self-leveling), Tremco “Dymeric”, Pecora “Urexpan NR-200”.

D. Backer Rod: Compressible, closed-cell non-gassing type compatible with required sealant.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Joints:

1. Install sealants to depths as recommended by the sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:

(a) For walks, sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, but neither more than 0.625" deep nor less than 0.375" deep.

(b) For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 0.5" deep nor less than 0.25" deep.

(c) For joints sealed with non-elastomeric sealants and calking compounds, fill joints to a depth in the range of 75% to 125% of joint width.

3.2 SCHEDULE OF SEALANT APPLICATION:

A. At joints in vertical planes on the exterior of the building and the interior face of through-expansion or control joints, provide non-sag type polyurethane or silicone sealant.

B. At joints in horizontal planes on the interior and exterior of the building, provide self-leveling type polyurethane sealant.

C. At joints on the interior of the building, except as indicated in item A above, provide acrylic-type sealant.

D. At the perimeter of plumbing fixtures and kitchen equipment, provide silicone-type sealant.

E. Set all thresholds in a full bed of urethane-type caulking.

F. After painting, provide clear silicone at the annular space between the pipe and flange for all new and repainted interior and above-grade process piping.

G. All chlorine rooms and all electrical rooms adjoining classified areas (e.q. pretreatment, digester control, etc.)

1. All walls are to be fully sealed to the structure's top and bottom and shall not allow migration of gasses or moisture.
2. Sealant around all electrical outlets, panel boxes, etc.
3. Expandable foam around sides and back of all electrical outlets, panel boxes, etc.
4. All openings, into computer and electrical room, into access floor space, and into space above ceiling shall be completely sealed.

**** END OF SECTION ****

SECTION 08 10 00 - DOORS AND FRAMES

PART 1 -- GENERAL

1.1 SUMMARY

A. Work specified in this section shall include all materials, labor, administration, and facilities required to furnish and install doors and frames as shown and specified.

1.2 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry Assemblies

B. Section 06 10 00 - Carpentry

C. Section 08 70 00 - Hardware

D. Section 09 91 00 - Wastewater Treatment Facility Painting

1.3 SUBMITTALS

A. Submit shop drawings prior to fabrication, each type of door and frame, frame conditions, and anchorage details, supplemented by suitable schedules covering doors and frames. The drawings shall show:

1. The location and size of glass and louver opening in the doors.
2. Detail connections of hollow metalwork to other work concealed in hollow metalwork.
3. The location and detail of field splice joints for frames too large to ship in one piece.
4. Detail joints required to accommodate expansion movement.

B. The Engineer may require samples for any or all of the following:

1. 12” x 12” section or door showing internal construction, edge detail, and reinforcement for butts.
2. 12” x 12” “L” section of the frame showing corner detail.
3. 12” length of the removable stop.
4. Sample stepped back of factory finish showing each step.

1.4 QUALITY ASSURANCE

A. Finished materials will be meticulously checked for compliance with this specification. Flatness will be checked, including diagonal, to ascertain tolerances.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle hollow metalwork in a manner to prevent damage and deterioration.

B. Provide packaging such as cardboard or other containers, separators, banding, spreaders, and paper wrappings to protect hollow metal items.

C. Store doors upright, in a protected dry area, at least one inch or more off the ground or floor and at least 1/4 inch between individual pieces.

D. Follow special storage and handling requirements of the manufacturer, if any.

E. Protect exposed finish surfaces of pre-finished items with masking tape.

1.6 GUARANTEE

A. Provide a written one-year guarantee against defects.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Doors of equivalent quality manufactured by Curries, Steelcraft, or Pioneer will be acceptable.

B. Doors of other manufacturers will be considered as an alternate. Fabrication and construction details must be submitted to the Engineer.

2.2 HOLLOW METAL FRAME

A. Sheet steel for frames shall be cold rolled prime quality steel.

B. Type: combination buck, frame, and trim.

C. The gauges shall be:

1. 14-gauge exterior frames for single and pairs of doors without sidelights.

2. 14-gauge exterior and vestibule door frames with sidelights.

3. 12-gauge exterior and vestibule door frames with hinge jambs on both sides of mullions.

4. 16-gauge interior frames.

D. The components to be used shall be (Material Minimums) hinge reinforcements 3/16” x 9” x 1-1/2”; strike clips 3/16” x 3” x 1-1/2” closer and holder 1-3/4”, 20” x 12 gauge; floor clip angles 2” x 3-1/2” x 12 gauge spreader channel 16 gauge, mortise cover boxes 16 gauge; rubber bumpers GJ64, 2 each jamb.

E. Factory assemble the frames square and true to a 1/8” (3.2 mm) tolerance. The corners shall be fully mitered and continuously welded to the reverse side. The faces shall be welded and ground smooth at mullion intersections.

F. Provide an anchor at each jamb for every two feet zero inches (610 mm) of door height or fraction thereof. Vary anchor types to provide positive fastening compatible with adjacent construction. (Use tee anchor at masonry.) Secure a metal clip angle at bottom of each jamb member for anchoring to the floor, with a minimum of two fasteners.

G. Applied stops shall be formed of 16-gauge steel corners made to a close, neat fit, and secured at 12-inch intervals with countersunk sheet metal screws.

2.3 HOLLOW METAL DOORS

A. Sheet steel for doors shall be cold-rolled stretcher level sheet steel.

B. The face sheets shall be 16 gauge exterior and 18 gauge interior.

C. Door thickness shall be 1-3/4” unless otherwise noted.

D. The components shall be material minimums, top and bottom door channel 18 gauge; hinge reinforcement 3/16” x 1-1/2” x 9”; closer reinforcement 12 gauge one-piece channel 14” long welded to both faces; 18 gauge filler channel to close door top flush. Lock reinforcement shall be heavy duty.

E. Provide seamless edge doors, factory assembled flat and true to a tolerance of 1/16” (1/6 mm) with steel stiffener inner reinforcement spaced at 6” and with injected polyurethane foam insulation.

F. All interior doors are to be insulated with polystyrene insulation or shall be a honeycomb door.

G. Glazing stops shall be 16-gauge steel, secured with countersunk sheet metal screws at a minimum interval of 12 inches.

H. Doors and frames designated on plans or Door and Frame Schedule to be “labeled” shall bear the Underwriter Laboratories label.

I. All exterior doors shall be steel stiffened for strength and shall use thermal break frame and thermal barrier saddle to achieve a U-value (ASTM 1363) of 0.29. Approved Manufacturer Ceco Trio-E, Curries Trio-E or equal.

PART 3 -- EXECUTION

3.1 PREPARATION FOR FINISH HARDWARE

A. The hardware supplier shall furnish the hollow metal manufacturer with an approved hardware schedule, hardware templates, and samples of hardware where necessary to ensure correct fittings and installation. The hollow metal manufacturer shall prepare the necessary shrinkage and cutouts for mortise and concealed hardware.

B. Reinforcements for both concealed and surface applied hardware shall be included. Drill and tap mortise reinforcement using templates at the factory. Install reinforcements with concealed connections designed to develop the full strength of the reinforcement.

3.2 FINISHING

A. Level doors and frames, grind smooth. Apply mineral filler to eliminate weld scar and other blemishes.

B. Factory-apply one coat of red oxide primer. Provide one-gallon primer to the field for touch-up work.

3.3 INSTALLATION OF FRAMES

A. Exercise care in the setting of frames to maintain scheduled dimensions, hold the head level and maintain jambs plumb and square.

B. Secure anchorages and connections to adjacent construction.

C. Whenever possible, leave frame spreader bars intact until frames are set perfectly square and plumb, and anchors are securely attached.

3.4 INSTALLATION OF DOORS

A. Apply hardware in accordance with the hardware manufacturer's template and instructions.

B. Adjust operable parts for correct function.

C. Installation of “label” doors shall conform to the Uniform Building Code.

3.5 PRIME COAT TOUCH-UP

A. Immediately after erection, sand smooth areas where prime coat has been damaged and touch-up with same primer, applied as shown. (Remove rust before touch-up is applied.)

B. Before painting is started, finish on frame and doors shall comply with finish on approved sample.

**** END OF SECTION ****

SECTION 08 51 13 - WINDOWS

PART 1 -- GENERAL

1.1 SUMMARY

A. Provide labor, material, facilities, and administration which is required to furnish and install all aluminum windows complete with associated framing members. Sealant as required to make the work of this section weatherproof, including sealant between aluminum members and adjacent building components. All trim members, cover and closure plates, reinforcement, anchors, screws, clips, and such other miscellaneous items as required for complete installation.

1.2 RELATED SECTIONS

A. Section 08 10 00 - Doors and Frames

B. Section 08 81 00 - Glass and Glazing

1.3 SUBMITTALS

A. Submit shop drawings showing details and method of anchorage, details of construction, finishes, method of assembling sections, location and reinforcing for hardware, the thickness of materials, sizes of components, joint and connection details, and details of components joining with other building materials.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. CMI Architectural Products, Inc.

B. Kawneer Company, Inc.

C. Champion Window and Door

2.2 MATERIALS

A. Aluminum Members: Alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for aluminum extrusions, ASTM B 209 for aluminum sheet or plate, and ASTM B 211 for aluminum bars, rods, and wire.

B. Carbon steel reinforcement of aluminum framing members shall comply with ASTM A 36 for structural shapes, plates, and bars, ASTM A 611 for cold-rolled sheet and strip, or ASTM A 570 for hot-rolled sheet and strip.

C. Glass and Glazing Materials: Comply with the requirements of the “Glass and Glazing” section of these specifications.

D. Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, zinc-plated steel, or other material warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors, and other components.

1. Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.125 inches thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard noncorrosive pressed-in splined grommet nuts.

2. Exposed Fasteners: Do not use exposed fasteners except for the application of hardware. For the application of hardware, use Phillips flat-head machine screws that match the finish of the member or hardware being fastened.

E. Weatherstripping shall be dual weather-stripped on all four sides of the frame and sash with vinyl weather stripping for a positive seal.

F. Unit shall be equipped with a gear operator that has all-steel hardened gears. Hinges shall be concealed from the exterior view. The hinge track shall be stainless steel. Sash shall be releasable from the frame without tools. The die-cast operator case and cam action sash lock shall be Brown tone. The mechanism shall provide 350-pound forced entry resistance.

G. Screens shall consist of charcoal fiberglass screen cloth set in a Bronze tone aluminum frame, complete with all necessary hardware.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The opening into which the window is to be installed should be level, plumb, square, and of proper dimensions.

B. The units' sills and heads should be level, jambs plumb, and the unit square before anchored into the wall. The window should be closed and locked during installation.

C. Allow 1/4" for caulking around perimeter of unit between exterior finish material and unit.

**** END OF SECTION ****

SECTION 08 70 00 – HARDWARE

PART 1 -- GENERAL

1.1 SUMMARY

A. It is the intent of this Section to schedule the complete line of hardware required and completely equip all doors and hollow metal work except as otherwise noted. Provide hardware items as required for correct door function even though not specifically noted. It shall be the hardware supplier's responsibility to furnish hardware in compliance with all applicable state and local codes and standards. Provide finish hardware as required for complete, operating, doors and frames with all required accessories.

B. The Owner of this Project has an existing master key system. All locksets and cylinders are to have interchangeable cores. Verify exact keying schedule and lock function with Owner and Engineer before ordering. Provide the Contractor with three construction master keys and temporary construction cores.

C. Where items of hardware are not definitely or correctly specified and are required for the intended service, such omission, error, or other discrepancies should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise, furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.2 SUBMITTALS

A. Following the award of the contract, the hardware supplier shall electronically submit copies of a complete detailed, Door and Hardware Institute (DHI) vertical-type hardware schedule prepared by or under the supervision of a DHI registered Architectural Hardware Consultant for review. Supply catalog cuts clearly marked showing the manufacturer's products to be used on this project. The schedule shall contain only the catalog numbers of **approved** items and manufacturers. If corrections and resubmissions are required, one copy of the schedule will be returned, with corrections indicated, in a searchable PDF document format.

B. The hardware supplier shall furnish an approved hardware schedule and all necessary templates to all factory-machined door and frame manufacturers. If required, the hardware supplier shall furnish physical hardware shipped prepaid to the door and frame manufacturers for applications.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for five years. Use experienced installers. Deliver, handle, and store materials in accordance with the manufacturer's instructions.

B. Comply with the following standards where applicable:

1. BMHA - Recommended Locations for Builder's Hardware.
2. NFPA 80 - Standards for Fire Doors and windows
3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures
4. UL - Building Material Directory
5. International Building Code (IBC) 2012 edition.
6. UL10C - Positive Pressure Fire Tests of Door assemblies

C. Furnish products of only one manufacturer for each type of hardware unless specified otherwise.

D. For fire-rated openings, include documentation for UL10C or other approved testing agency stating the hardware has passed UL10C testing and meets UL10C requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. All items shall be properly and carefully packed to guard against damage in transit.

B. All hardware for each opening shall be packed separately and each package shall be clearly marked to show its contents and its intended place in the building.

C. The Contractor shall check hardware against the approved hardware schedule upon delivery and provide a dry, secure storeroom to protect against loss or damage.

D. Prevent soiling of hardware during handling.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. General: Supply hardware new and free from scratches, mars, and defects. Furnish hardware complete with accessories of proper size and design required for the purpose for which it is to be used complete with all screws, shield, or other anchorage devices necessary for complete installation onto or into supporting surfaces for which the item is intended. All exposed screw heads shall be Phillips type. Functioning hardware having stamped, or spun parts is not acceptable unless noted otherwise. The items specified below establish a standard of quality.

Product	Specified	Acceptable
Butt Hinges	Ives	Hager, McKinney, Bommer, Stanley
Continuous Hinges	Markar	Prior Approved Equal
Flush Bolts	Ives	Door Controls, Hager
Exit Devices	Von Duprin	Prior Approved Equals by Norton, Dormakaba
Locks and Latches	Schlage	Corbin, Russwin, Best
Pulls, Push Bars, Push/Pull Plates	Hiawatha	Hager, Burns, Ives
Coordinators	Ives	Door Controls, Hager
Closers	LCN	Prior Approved Equals by Norton, Dormakaba
Automatic Operators	LCN	Dor-O-Matic, Besam, Horton
Protective Plates	Hiawatha	Hager, Burns, Ives
Overhead Stops	Glynn Johnson	Rixson, Sargent
Wall Stops	Ives	Hager, Burns
Magnetic Hold Opens	LCN	ABH, Rixson
Thresholds, Sweeps, Weatherstrip, Gaskets	Reese	Pemko, NGP
Key Cabinets	Lund	Key Controls, Telkee

B. Hinges, butts, and pivots: 4 ½" x 4 ½", full-mortise, 5 knuckle ball-bearing type. Provide proper butt width to clear trim and allow a full 180-degree door swing. All butts shall have flat button tips unless noted otherwise. All butts shall be modern 'Slim Line' type. All exterior doors shall have NRP Hinges. The following is a table of butt types in the manufacturer's catalog numbers, which are considered equal. No substitutions will be allowed.

	Ives	Hager	Bommer	McKinney	Stanley
Type 1 – ANSI A8111 (Hvy. Wt. BB Steel)	5BB1HW	BB1168	BB5004	T4B3786	FBB168
Type 2 - ANSI A5111 (Hvy. Wt. BB Stain. Steel)	5BB1HW 630	BB1199	BB5005	T4B3386	FBB199
Type 3- ANSI A8112 (Std. Wt. BB Steel)	5BB1	BB1279	BB5000	TB2714	FBB179
Type 4- ANSI A5112 (Std. Wt. BB Stain. Steel)	5BB1 630	BB1191	BB5002	TB2314	FBB191
Type 5- ANSI A8133 (Std. Wt. PB Steel)	5PB1	1279	5000	T2714	F179
Type 6- ANSI A5133 (Std. Wt. PB Stain. Steel)	5PB1 630	1191	5002	T2314	F191

Butt types shall be furnished as follows:

All exterior outswing doors	Type 2
Typical interior doors 36” wide & over	Type 1
Typical interior doors less than 36” wide	Type 3
Interior doors subject to moisture or corrosive atmosphere 36” wide & over	Type 2
Interior doors subject to moisture or corrosive atmosphere less than 36” wide	Type 4

C. Locksets and latch sets: Extra Heavy Duty, commercial-grade (Grade 1) mortise and cylinder locksets, latch sets, and trim, all products of one manufacturer. 2 3/4” Backsets. Provide wrought box and strikes with proper lip length to protect trim but not to project more than 1/8” beyond trim, frame, or inactive leaf. Where required, provide open back and protected back strikes to allow practical and secure operation. Schlage D & L Series, Corbin Russwin CL3400, and ML2200 Series or approved equals. Cylinders at exterior doors to be similar to Primus Controlled Access cylinders by Schlage or approved equal. Door lever handles similar in design to Rhodes by Schlage or approved equal.

D. Lock Cylinders and Keying:

1. All locks are to be master keyed as directed by the Owner. All cylinders shall have interchangeable cores. Verify the exact keying schedule and lock function with the Engineer and the Owner’s Representative before ordering.

2. Furnish three change keys for each lock. Furnish six master keys for each set. Furnish six grand master keys. Provide the Contractor with three construction master keys and temporary construction cores.

E. Flush Bolts and Dust Proof Strikes:

1. Acceptable manufacturers and respective catalog numbers:

Ives	Door Controls	Hager
FB458	780	282D
FB31P	842	292D
FB41P	942	291D
FB51P	845	293D
FB61P	945	294D
DP2	80	280X

2. Furnish dustproof strike DP2 for the bottom bolt.

F. Coordinators:

1. Acceptable manufacturers and respective catalog numbers:

Ives	Door Controls	Hager
COR	600	297D

2. Furnish a COR series coordinator for labeled pairs of doors equipped with automatic flush bolts and those with vertical rod/mortise lock fire exit device combinations with overlapping astragals.

3. Furnish filler bars to fill the complete opening width, closer mounting brackets, carry bars, and special preparation for top latches where applicable.

G. Exit Devices:

1. Acceptable manufacturer and respective catalog numbers:

Von Duprin	No Substitution
99 Series	
94 Series	

2. Surface applied strikes shall be roller type unless noted otherwise.

3. Devices to be equipped with a sound dampening feature to reduce touchpad return noise.

4. On full glass doors there shall be no exposed fasteners on the back of the mechanism visible through the glass.

5. Provide thru bolts as required.

6. Devices shall be the product of one manufacturer

7. Exit devices specified “LBR” are to be supplied with surface vertical rods “Less Bottom Rod” (LBR) and no strikes installed on the floor.

8. Hollow metal removable mullions shall be keyed and removed by a standard mortise cylinder.

9. Exit devices that are supplied with levers shall match the trim design of locks and latches unless noted otherwise.

H. Closers:

1. Acceptable manufacturers and respective catalog numbers:

	LCN	Norton	Dormakaba
Exterior Doors:	4111 EDA	PR7500	8901SPA
Interior Doors: (Push Side Mounting)	4111 EDA	PR7500	8901SPA
Interior Doors: (Pull Side Mounting)	4011	7500	8901

2. All closers to be heavy-duty, double-arm type and have separate adjusting valves for latching speed, closing speed, and backcheck. It shall be the hardware supplier’s responsibility to furnish door closer sizes to comply with the manufacturer’s recommendations for individual sizes and locations. Furnish one size larger for exterior doors.

3. Closers shall use high-strength cast cylinders and one-piece forged steel pistons.

4. Closers shall use a stable fluid withstanding temperature ranges of +120 deg. F to -30 deg. F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with UL10C.

5. Closers shall have field adjustable spring power that at the low end is capable of meeting ADA requirements and, at the high end, is capable of controlling a 44-inch exterior door.
6. Furnish complete with mounting brackets, drop plates, special shoes, thru-bolts, overhead stop, and hold open functions as may be required by the door and frame conditions and/or noted in the door schedules. Where wall conditions permit, all closers shall swing 180 degrees.
7. Install closers on the room side of corridor doors, stair side of stairways, and interior side of exterior doors. Provide closers for all labeled doors, whether called for in the door schedule and hardware groups or not.
8. All closers shall be the product of one manufacturer.

I. Kick Plates and Mop Plates: 16 gauge (0.050") stainless steel. Kick plates shall be 10" high and 2" less than the door in width (LDW). Mop plates shall be 4" high and 2" less than the door in width (LDW). Plates shall have countersunk holes and beveled edges on four sides. Provide kick plates on the push side of all doors with closers. Hiawatha, Hager, Burns, and Ives or approved equals.

J. Overhead Stops:

1. Acceptable manufacturers and respective catalog numbers:

Glynn Johnson	Rixson	Sargent
GL90 Series	9 Series	590 Series
GL100 Series	1 Series	690 Series
GL450 Series	10 Series	1540 Series

2. Furnish GJ450 Series overhead stops for doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in the door schedule or hardware groups.
3. Furnish sex bolt attachments for wood and mineral core doors unless doors are supplied with proper reinforcing blocks.

K. Wall Stops and Holders:

1. Acceptable manufacturers and respective catalog numbers:

Ives	Hager	Burns
WS407CVX	232W	570
WS407CCV	236W	575
WS11X	255W	530
WS40	326W	

2. Where wall stops are not applicable, furnish overhead stops.

L. Thresholds and Weatherstripping:

1. Acceptable manufacturers and respective catalog numbers:

	Pemko	National Guard	Reese
Thresholds:	177_T	804N	S487A
Thresholds (ADA):	2005_T	896N	S483A
Weatherstrip:	2891APK	700NA	755A
Head & Jamb Gasket:	S88D	2525	797B
Drip Cap:	346A	16A	R201A

	Pemko	National Guard	Reese
Thresholds:	177_T	804N	S487A
Sweeps:	18061CP	B606A	964A
Smoke Astragal:	S77	5060	

2. Where specified in the door schedule or hardware groups, furnish the above products unless otherwise detailed in the schedule or groups.

3. Furnish head/jamb gaskets and edge stile astragals for pairs at fir labeled doors whether listed in the door schedule and hardware groups or not. Provide material based on passing UL10C.

4. Coordinate with the door manufacturer the intumescent fire and smoke material for fire-rated openings as required by the door and frame manufacturer to comply with UL10C.

M. Push Plates and Pulls:

1. Acceptable manufacturers and respective catalog numbers:

	Hiawatha	Hager	Burns
1" Diameter Straight Pull:	536B	4J	26C
1" Dia. Push Bar & Pull:	1081	153	422 X 26C
Push/Pull Plate:	200F	30S 4 X 16	54
Pull:	523A	3G	25 B

2. The length of push bars shall be sufficient to mount each end of the center of the door stile. Push bars on flush doors shall be 3" less than door width. Mount all push bars and pulls back-to-back with stud or bolts and set screw. Set screw to be on the inside.

N. Key Cabinets:

1. Acceptable manufacturers and respective catalog numbers:

Lund	Key Control	Telkee
1200-1205AA	M228-2480	RWC-AWC

2. Furnish one Model 1200 or 1205 AA key cabinet with a capacity of 1.5 times the number of key sets.

O. Finish: Except where indicated otherwise in the door schedule or hardware groups or herein, hardware finishes shall be applied over base metals as specified in the following finish schedule:

Product	Finish and Base Material
1. Butt Hinges	26D (BHMA #612)
2. Continuous Hinges	32D
3. Flush Bolts	US26D
4. Exit Devices	US26D
5. Locks and Latches	US26D
6. Pulls, Push Bars, Push/Pull Plates	US32D
7. Coordinators	Prime painted or mill aluminum
8. Closers	Aluminum
9. Protective Plates	US32D
10. Overhead Stops	US26D
11. Wall Stops & holders	US32D

12.	Thresholds	Mill Aluminum
13.	Weatherstrip, Sweeps, Drip Caps	Aluminum Anodized
14.	Magnetic Holders	US26D

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Examine doors, frames, and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until defects are corrected.

3.2 INSTALLATION

A. Install each hardware item in strict compliance with the manufacturer's printed instructions and recommendations, using only fasteners supplied by or called for by the manufacturer.

B. Set units level, plumb, and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

C. Install hardware on UL labeled openings in accordance with the manufacturer's requirements to maintain the label and fire rating of the door.

D. Install per door and/or frame manufacturer's supplemental "S" label instructions on fire-rated openings.

E. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.

F. Drill and countersink units which are not factory prepared for anchorage fasteners. Space anchors and fasteners in accordance with industry standards.

G. Follow guidelines of DHI "Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames", BMHA recommended mounting locations, hardware manufacturer's instructions and as follows:

1.	Butts and Hinges	Bottom of butt 10" above the floor. Top of top butt 5" below door head. Other butts spaced equally.
2.	Door Levers	40" above the finish floor.
3.	Deadbolts	48" above the finish floor to the center of the cylinder.
4.	Push Plates	1/2" from the edge of paired doors. 1" from the edge of single doors.
5.	Door Pulls	Top bolt at 44" above the finish floor. Backset at 2 3/4" from the edge or centered in door stile.
6.	Exit Devices	Center of the crossbar at 36" above the finish floor.
7.	Kick Plates	Bottom within 1/8" of door bottom.
8.	Wall Stops	Install wall stops to engage levers and pulls. Do not mount wall stops on casework, cabinet work, or equipment.

H. Deliver to the Owner one complete set of installation and adjustment instructions, and tools as furnished with the hardware.

3.3 ADJUSTMENT & CLEANING

A. At final completion, adjust and check each operating item of hardware and each door to ensure proper operation and function of every unit. Lubricate moving parts with the type of lubrication recommended by the manufacturer.

B. Replace any units that cannot be adjusted and lubricated to operate freely and smoothly as intended for the application.

C. Instruct the Owner's personnel in the proper adjustment of the hardware.

D. Clean and restore hardware to the original finish.

PART 4 -- SCHEDULE

4.1 HARDWARE SCHEDULE

A. Furnish hardware items in the amounts indicated unless additional hardware is required for a complete and operable facility. Ensure completeness, proper function, and proper application of hardware for each door.

B. The following schedule of finish hardware shall be furnished:

Group #1 (Exterior Double Doors)				
Each Door to Have:				
3	Pr. Butts		NRP	
1	Lockset		L9453	Schlage
1	Hold Open (Inactive Door)		GL90 Series X 90	Glynn Johnson
1	Door Closer (Active Door)		4111 EDA X 90	LCN
2	Kick Plates			
1	Astragal			
1	Threshold	(Drop Down Sill)	S490AN	Reese
	or	(Straight Thru Sill)	S486A	Reese
2	Sweeps			
1	Weatherstripping			
1	Flush Bolt (Top & Bottom of Inactive Door)			
1	Rain Drip @ Frame Head			
Group #2 (Interior Single Door)				
Each Door to Have:				
1 ½	Pr. Butts		NRP	
1	Latch Set		L9010	Schlage
1	Door Closer		4111 EDA X 90	LCN
1	Kick Plate			

Group #3 (Interior Single Door)			
Each Door to Have:			
1 1/2	Pr. Butts	NRP	
1	Lockset	L9453	Schlage
1	Door Closer	4111 EDA X 90	LCN
1	Kick Plate		
1	Threshold	S293A	Reese
1	Sweep		
1	Weatherstripping		
Group #4 (Exterior Single Door)			
Each Door to Have:			
1 ½	Pr. Butts	NRP	
1	Lockset	L9453	Schlage
1	Door Closer	4111 EDA X 90	LCN
1	Kick Plate		
1	Threshold (Drop Down Sill)	S490AN	Reese
	Or (Straight Thru Sill)	S486A	Reese
1	Sweep		
1	Weatherstripping		
1	Rain Drip @ Frame Head		
Group #5 (Exterior Single Door with Emergency Hardware)			
Each Door to Have:			
1 ½	Pr. Butts	NRP	
1	Exit Device (with exterior lever)	99L-992L-R/V-06	Von Duprin
1	Door Closer	4111 EDA X 90	LCN
1	Kick Plate		
1	Threshold (Drop Down Sill)	S490AN	Reese
	Or (Straight Thru Sill)	S486A	Reese
1	Sweep		
1	Weatherstripping		
1	Rain Drip @ Frame Head		
Group #6 (Exterior Double Door with Emergency Hardware)			
Each Door to Have:			
3	Pr. Butts	NRP	
2	Exit Device (with exterior lever)	99L-992L-R/V-06	Von Duprin
2	Door Closer	4111 EDA X 90	LCN
1	Mullion	KR4954	
2	Kick Plates		
1	Threshold (Drop Down Sill)	S490AN	Reese
	Or (Straight Thru Sill)	S486A	Reese
2	Sweeps		
1	Weatherstripping		
1	Rain Drip @ Frame Head		

Group #7 (Interior Double Doors)			
Each Door to Have:			
3	Pr. Butts	NRP	
1	Lockset	L9453	Schlage
1	Hold Open (Inactive Door)	GL90 Series X 90	Glynn Johnson
1	Door Closer (Active Door)	4111 EDA X 90	LCN
2	Kick Plates		
1	Astragal		
1	Threshold	S290AN	Reese
2	Sweeps		
1	Weatherstripping		
1	Flush Bolts (Top & Bottom of Inactive Door)		

**** END OF SECTION ****

SECTION 08 81 00 - GLASS AND GLAZING

PART 1 -- GENERAL

1.1 SUMMARY

A. Work specified in this section shall include all materials, labor, administration, and facilities required to furnish and install all glass and glazing as shown and specified.

1.2 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry Assemblies

B. Section 08 10 00 - Doors and Frames

1.3 SUBMITTALS

A. Manufacturer's Certificate that materials meet requirements of this section.

B. Manufacturer's glazing instructions.

1.4 QUALITY ASSURANCE

A. Requirements of regulatory agencies: comply with FS DD-G-451c.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Schedule deliveries to coincide with glazing schedules. Do not move partially unpacked cases of glass.

B. Check glass surfaces and all edges for damage prior to transporting. Use gloves, safety shoes, hard hats, and glazing gauntlets, as required, when transporting lites of glass.

C. Support cases on both sides when stored vertically. Stack individual lites on edge with a slope of 5 to 7 from vertical; lean against uprights. If the glass must be laid flat, use felt-covered tables free of abrasive contaminants.

D. Protect glass from weld spatter, sandblasting, and other impact or chemical damage. Mark glazed openings during construction periods. When using tape to mark glazed openings, do not allow adhesives to touch glass surfaces.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Exterior Glass: do not install glazing members in wet weather.

B. Minimum Temperature: 40°F (4°C).

1.7 GUARANTEE

A. The Contractor will be fully responsible for glass breakage until the project is accepted by the Owner.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Viracon, Inc.

B. Cardinal Insulated Glass Company

C. PPG Industries, Architectural Glass Division

D. Or equal

2.2 PRODUCTS

A. Plate Glass

1. 5/8” insulating glass with 7/16” air space.

2. Tempered Glass: provide tempered glass at doors and sidelights.

B. Glazing Sealants and Accessories

1. Follow the glass manufacturer’s written instructions for the type of glass to be installed.

PART 3 -- EXECUTION

3.1 INSPECTION

A. Verify that frames are installed with headers and mullions level, jambs plumb, floor level without projections, and correctly dimensioned.

B. If required by the manufacturer, obtain his representative’s approval of installation procedure and details.

C. Begin installation of glass only when conditions are satisfactory.

3.2 INSTALLATION

A. Comply without deviation with manufacturer’s glazing instruction.

B. Do not begin installation until installation methods have been approved by the Engineer.

3.3 CLEANING

A. Leave glass surfaces clean and free of foreign substances. Remove protective markings and/or panels. Use “Windex” or other non-ammonia commercial cleaner.

B. Clean glass only at such time approved by the Engineer.

**** END OF SECTION ****

SECTION 09 51 23 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical tiles.
2. Metal suspension system.

B. Related Requirements:

1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

a. Lighting fixtures.
b. Diffusers.
c. Grilles.
d. Speakers.
e. Sprinklers.

f. Access panels.

g. Perimeter moldings.

7. Show operation of hinged and sliding components adjacent to acoustical tiles.

8. Minimum Drawing Scale: 1/8 inch = 1 foot.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size tiles equal to [2]<Insert number> percent of quantity installed.

2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to [2]<Insert number> percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Suspended Acoustical Tile Ceiling System: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A in accordance with ASTM E1264.

2. Smoke-Developed Index: 50 or less.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTIC PANELS **(ACT-1)**

A. Manufacturers: Provide product as indicated in the Drawings. Subject to compliance with requirements and Architect's approval, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. USG Corporation
2. Armstrong World Industries, Inc
3. CertainTeed Corporation

B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Classification: Provide tiles as follows:

1. Pattern: Lightly textured panel
2. Color: White
3. Light Reflectance (LR): Not less than .83
4. Ceiling Attenuation Class (CAC): Not less than 35
5. Noise Reduction Coefficient (NRC): Not less than .55
6. Edge/Joint Detail: As indicated by manufacturer's designation (Square)
7. Thickness: 5/8" Thick
8. Modular Size: 24" x 24"

2.4 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

C. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings in accordance with ASTM C636/C636M manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

8. Do not attach hangers to steel deck tabs.

9. Do not attach hangers to steel roof deck. Attach hangers to structural members.

10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching

to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Arrange directionally patterned acoustical tiles as follows:

1. As indicated on reflected ceiling plans.

G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.

1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.

2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches o.c.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.

2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

B. Acoustical tile ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

****END OF SECTION****

SECTION 09 91 00 - WASTEWATER TREATMENT FACILITY PAINTING

PART 1 -- GENERAL

1.1 SUMMARY

A. This section includes painting all interior and exterior surfaces for wastewater treatment facilities.

B. Painting includes surface preparation, priming, intermediate and finish coats, inspection, cleaning, and touch-up of surfaces and equipment in addition to shop priming and surface treatment.

C. The painting subcontractor shall examine the specifications for the various other trades and shall thoroughly become familiar with all of their provisions regarding their painting; the painting subcontractor shall understand that all surfaces that are left unfinished by requirements of other specifications shall be painted or finished as a part of this contract.

D. Unless otherwise approved by the Engineer in writing, all coatings applied under a single paint system shall be the product of a single manufacturer.

1.2 RELATED SECTIONS

A. Section 04 20 00 – Unit Masonry Assemblies (Concrete Masonry Units)

B. Section 06 10 00 – Rough Carpentry

C. Section 07 62 00 – Flashing and Sheet Metal

D. Section 07 90 00 – Caulking and Sealants

E. Section 08 10 00 – Doors and Frames

1.3 SUBMITTALS

A. Information shall be submitted as per Section 01 33 00 “Submittals”.

B. Information submitted shall include, but not be limited to the following:

1. Paint manufacturer's name with paint specification details.
2. Color charts of materials for selection of color.
3. Technical and material safety data sheets on each paint material used.
4. Manufacturer’s recommended application procedures.
5. Information regarding pipe identification system and valve tags.

1.4 QUALITY ASSURANCE

A. The label of Containers shall include the manufacturer's name, type of paint (stock number), color and instructions for reducing where applicable, mixing and application instructions, drying or curing time, storage, and temperature limits.

B. Field Quality Control shall be established by inspecting the first finished room, space, or item as a project of each color scheme for color, texture, and workmanship. The first acceptable room, space, or item shall be designated as the project standard for each color scheme. The minimum space for determining the quality of work for spray application shall not be smaller than 100 square feet.

C. The painting work shall be in conformance with the following applicable standards:

1. American National Standards Institute (ANSI)

(a) A 13.1 - Scheme for the Identification of Piping Systems.

(b) Z 53.1 - Safety Color Code for Marking Physical Hazards.

2. Association for Materials Protection and Performance (AMPP)

(a) SP 1 - Solvent cleaning. Removes oil grease, soil, etc., with other methods to remove rust, paint, and mill scale.

(b) SP 3 - Power Tool Cleaning. Removes loose material. Not intended to remove all scale or rust.

(c) SP 5 - White Metal Blast Cleaning. Removes all scale, rust, coating, and foreign matter. Leaves surface gray-white uniform metallic color.

(d) SP 6 - Commercial Blast Cleaning. Removes all scale, rust, coating, and foreign matter. Random staining is limited to 33 percent of surface area.

(e) SP 7 - Brush-Off Blast Cleaning. Removes only loose material, remaining surface tightly adhered and abraded to give anchor pattern.

(f) SP 10 - Near-White Blast Cleaning. Removes all scale, rust, coating, and foreign matter. Random staining is limited to 5 percent of surface area.

D. The Contractor shall control the dry film thickness of the coatings on metal surfaces with a correctly calibrated thickness gauge, type to be approved by the Engineer. The Contractor shall supply gauge thickness samples for gauge reference and calibration.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Tnemec

B. Sherwin Williams

C. Or Equal

2.2 LABELS

A. All exposed piping shall be provided with identifying labels. Labels shall include the piping system designation and a flow arrow. Identifying labels shall be provided adjacent to valves or fittings, near connections to equipment, and on both sides of walls penetrated. Pipe labels shall be Seton “Setmark” pipe markers. Markers for piping smaller than 6-inches shall be snap-on type similar to Seton Setmark type SNA. Markers for piping larger than 6-inches shall be strap-on similar to Seton Setmark Type STR. Markers shall be factory printed. Pipe label size shall be as follows:

Pipe Size	Letter Height
1/2” to 1-1/4”	1/2”
1-1/4 to 2”	3/4”
2” to 6”	1-1/4”
6” to 10”	2-1/2”
10” and Over	3-1/2”

PART 3 -- EXECUTION

3.1 SUBSTRATE EXAMINATION

A. Examine substrates and surfaces and conditions under which work is to be performed. Notify, in writing of any conditions detrimental to the performance of the work. Do not proceed with this work until unsatisfactory conditions have been corrected; starting of painting work shall be construed as acceptance of surface and conditions within any particular area.

B. Do not paint over dirt, rust, scale, grease, moisture, or conditions otherwise detrimental to the formation of a durable paint film.

3.2 SURFACE PREPARATION

A. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove mounted accessories if necessary for the complete painting of items or adjacent surfaces. Following completion of the painting of each space or area, reinstall removed items using workmen skilled in the trades involved.

B. Perform preparation procedures for each substrate in strict accordance with the paint manufacturer's written instructions and as outlined in the following schedule:

1. P1: SSPC-SP1 Solvent Cleaning

   (a) The removal of all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from surfaces with solvents or commercial cleaners using various methods of cleaning such as wiping, dipping, steam cleaning, or vapor degreasing.

2. P2: SSPC-SP2 Hand Tool Cleaning

   (a) The removal of all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter by the use of non-power hand tools. Hand tool cleaning will not remove adherent mill scale, rust, and paint. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.

3. P3: SSPC-SP3 Power Tool Cleaning

   (a) The removal of all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter by the use of power-assisted hand tools. Power tool cleaning will not remove adherent mill scale, rust, and paint. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Power Tool Cleaning provides a slightly higher degree of cleanliness than Hand Tool Cleaning but is not regarded as adequate surface preparation for long-term exterior exposure of most high-performance coating systems.

4. P4: SSPC-SP6 or NACE 3 Commercial Blast Cleaning

   (a) The removal of all visible oil, grease, dirt, dust, mill scale rust, paint, oxides, corrosion products, and other foreign matter by compressed air nozzle blasting, centrifugal wheels, or another specified method. Discoloration caused by certain stains shall be limited to no more than 33 percent of each square inch of surface area. A blast profile of 1.5 - 2.0 mils shall be achieved.

5. P5: SSPC-SP7 or NACE 4 Brush-Off Blast Cleaning

   (a) The removal of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint by compressed air nozzle blasting, centrifugal wheels, or another specific method. Tightly

adherent mill scale, rust, and paint may remain on the surface. Mill scale, rust, and paint are considered tightly adherent if they cannot be removed by lifting will a dull putty knife.

(b) All concrete shall be cured for a minimum of 28-days prior to coating.

6. P6: SSPC-SP10 or NACE 2 Near-White Metal Blast Cleaning

   (a) The removal of all visible oil, grease, dirt, dust, mill scale rust, paint, oxides, corrosion products, and other foreign matter by compressed air nozzle blasting, centrifugal wheels, or another specified method. Discoloration caused by certain stains shall be limited to no more than 5 percent of each square inch of surface area. A blast profile of 1.5 - 2.0 mils shall be achieved.

7. P7: SSPC and NACE WJ-4 Low Pressure Wash

   (a) The entire surface shall be high pressure washed at a minimum of 1500 p.s.i. removing all loose paint, dirt, or foreign matter. Upon completion of the pressure washing procedure, rinse all areas with potable water and allow to dry. Dryness of the surface shall be verified by use of a polyethylene moisture test or a reading of 17% or less utilizing a moisture meter.

8. P8: SSPC and NACE WJ-4 Low Pressure Wash with Additive

   (a) The entire surface shall be low pressure washed with a biodegradable, phosphate, and residue-free additive. A stiff bristle brush shall be used to assist in the removal of all dirt, mildew, dust, and other foreign matter. All failed and/or rusted metal surfaces shall be prepared by power tool cleaning by any of the methods outlined in the Steel Structures Painting Council SSPC-SP3. Feather rough edges to provide a smooth transition from the existing sound coating.

9. P9: Acid Etching

   (a) Remove residual dust and dirt with water using a high-pressure hose. Remove excess water and allow concrete to dry until the surface is damp. Uniformly apply a solution of 1-part Muriatic Acid and 2 - 4 parts fresh water utilizing low-pressure spray equipment or sprinkling cans. When bubbling begins to subside immediate rinse with clean water while scrubbing with a stiff bristle broom. Test with pH paper and continue the rinsing operation until a pH of 7 or higher is obtained. Allow the floor to dry thoroughly before coating.

10. P10: Concrete

    (a) Prepare cementitious surfaces of concrete, concrete block, cement plaster, and mineral fiberboard to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

11. P11: Wood

    (a) Clean wood surfaces to be painted of all dirt, oil, or other foreign substances with scrappers, mineral spirits, and sandpaper, as required. Use sandpaper to smooth those finished surfaces exposed to view. Scrap and clean small, dry seasoned knots and apply a thin coat of white shellac or other approved sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Use sandpaper smooth when dried.

12. P12: SSPC-SP CAB-1 Thorough Blast Cleaning

    (a) Blast all surfaces to remove all laitance and solid contaminants. Blasting shall be performed sufficiently close to the surface so as to open up surface voids, bug holes, air pockets, and other subsurface irregularities.

13. P13: SSPC-SP11 Power Tool Cleaning to Bare Metal

    (a) The removal of all visible oil, grease, dirt, mill scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of the pits if the original surface is pitted. Differs from SSPC-SP3 in that it requires more thorough cleaning and a surface profile of not less than 1 mill (25 microns). For areas where abrasive blasting is prohibited or not feasible.

14. P14: Pits and Seams (Epoxy Filler)

    (a) Spot fill all pits deeper than and/or all seams wider than one-eighth of one inch with Tnemec Series 63-1500 Filler Surfacer or Sherwin Williams Steel Seam FT 910 Patching/Surfacer. The Steel Seam FT 910 Patching/Surfacer may be “smoothed out” with a brush and a small amount of water 10-15 minutes after application. Excess material shall be scraped off with a wide putty knife and smoothed out with a small brush or squeegee dampened with Thinner #2.

15. P15: Chloride Contaminated Substrates

    (a) Step 1: The entire surface shall be high pressure washed (140 deg. F. min.) at a minimum of 3000-5000 p.s.i. with a minimum 3-4 GPM delivery at the nozzle, to remove all visible salts, loose paint, dirt, or foreign matter.

    (b) Step 2: Upon completion of the pressure washing procedure, all surfaces shall be abrasive blast cleaned to a Commercial Finish, removing mill scale, rust, dirt, or foreign matter by any of the recommended methods outlined in Steel Structures Painting Council's Specification SSPC-SP6.

    (c) Step 3: Repeat Step 1. Utilizing a Surface Contamination Analysis Test to verify chloride levels of substrate. If levels exceed 5 micrograms per square centimeter, consult the coating manufacturer for a recommendation.

    (d) Step 4: Upon completion of the pressure washing procedure, all surfaces shall be abrasive blast cleaned to remove all rust blooms that may have recurred. A blast profile of 1.5 - 2.5 mils shall be achieved.

3.3 MATERIAL PREPARATION

A. Prepare painting materials in accordance with the manufacturer’s directions. Mix materials before application to produce uniform density. Stir as required during the application of materials. Do not stir surface film into the material; remove film and if necessary, strain materials before using.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

3.4 APPLICATION

A. Manufacturer's instructions shall be strictly followed in the application of proprietary coatings.

B. All coatings shall be applied by experienced and qualified painting subcontractors.

C. Each coat shall produce a minimum dry film thickness as specified herein. In areas where this thickness is not developed, sufficient additional coats shall be applied to produce it.

D. Care shall be exercised not to damage adjacent work during sandblasting operations.

E. Coatings shall be applied only in satisfactory painting weather and conditions as per the coating material manufacturer's product data sheets. Work area shall be free of all contaminants (inclusive of

airborne dust, debris, insects, etc.) at the time of painting and while the film is forming. Steel temperature surface shall be a minimum of 5°F above the dew point. Epoxy may not be applied when ambient or steel temperatures are below 40°F, or when the humidity is above 80 percent. Urethane may not be applied when ambient or steel temperature is below 50°F, above 110°F, or when the humidity is above 70 percent.

F. Drying times shall be not less than called for in the manufacturer's instructions.

G. Spray painting shall be conducted under controlled conditions, and the Contractor shall be fully responsible for any damage to adjacent work or adjoining property occurring from spray painting.

H. Cover or otherwise protect surfaces not being painted, areas not to be painted, and the work of other trades. Remove protective materials when appropriate.

I. Install adequate ventilation equipment in all areas of application to ensure that at no time does the content of air exceeds the Threshold Limit Value given on the manufacturer's Safety Data Sheets for the specific coatings being applied.

J. After the Engineer's approval of surface preparations, apply the first coat of the system the same day. Use properly designed brushes, rollers, and spray equipment for all applications. The film thickness of each system shall meet the minimum specified, but not exceed it by more than 20 percent.

K. Painting shall remain 3 inches away from the unprepared surface of any substrate. When steel is blasted, do not coat the last 3 inches of the blasted area until the unprepared adjacent surface is prepared.

L. Each coat will be inspected by the Engineer prior to the application of the next coat. Areas found to contain runs, overspray, roughness, or other signs of improper application shall be required to be recoated in accordance with the Engineer's instructions.

M. Woodwork shall be sanded smooth, and knots and pitch streaks shall be painted with a thick coat of orange shellac or a resin sealer, except for stained wood. Nail holes and minor imperfections shall be filled with putty between the first and second coat; the color of putty shall match the stain in the case of stained work.

N. Interior surfaces of ducts behind grilles and diffusers, where the duct is visible, shall be painted flat black.

O. Unless otherwise directed or permitted by the ENGINEER, all piping, vents, conduits, items of equipment, miscellaneous fixtures, appurtenances, and the like, shall be painted to match the color of adjacent wall and ceiling surfaces.

P. Provide daily cleanup of both storage and working areas and removal of all paint refuse and trash.

3.5 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damages by cleaning, repairing or replacing, and repainting.

B. Provide “wet paint” signs as required to protect newly painted surfaces. Remove temporary protective wrappings provided by others for the protection of their work after completion of painting operations.

3.6 CLEAN-UP

A. During the progress of work, dispose of discarded paint materials, rubbish, cans, and rags. Upon completion of painting work, clean all paint-spattered surfaces by proper methods of washing and scraping, using care to not scratch or otherwise damage finished surfaces.

3.7 CAULKING PIPE FLANGE ANNULAR SPACE

A. The annular space between the flange and the pipe in all vertical and horizontal pipes shall be caulked with clear silicone sealant after the finish paint to prevent condensate from collecting in the space. All exposed pipe threads and annular space between pipe flange and pipe shall be stripe coated with base coat prior to painting.

3.8 SCHEDULES

A. Areas to be painted include the following:

1. Hollow metal doors and frames, interior and exterior (System A).
2. Exposed steel lintels, interior, and exterior (System A).
3. Interior of the buildings (see finish schedule on plans) (System G).
4. Paint louvers and grilles, interior and exterior (System A).
5. Paint exterior of all equipment, blowers, motors, valves, and exposed piping (System D).
6. Ductile iron piping (System A or C).
7. Aeration piping (System F).
8. Miscellaneous exposed metal including galvanized HVAC ducts (System A or C).
9. Seal exterior brick (System N).
10. Concrete floors where indicated (System P).
11. Exposed rebar on cut concrete surfaces
12. All concrete process tanks shall be painted as scheduled below. Interior walls shall be coated from top of wall to 6-ft below the water level. Sludge storage tank and open channel walls shall be coated from the top of wall to the sloped base slab.
    (a) Open Channels (pretreatment) (System J)
    (b) Anoxic and Selector Basin Interior Walls (System I)
    (c) Aeration Basin Interior Walls (System I)
    (d) Control Structure Interior Walls (System I)
    (e) Scum Interior Walls (System I)
    (f) Clarifier Interior Walls (System I)
    (g) Clarifier Launder and Effluent Box (System I)
    (h) Sludge Storage Tanks (System H)
    (i) Mix Tank, Chlorine Contact, SO2, and Effluent Channel (System I)
    (j) Reaeration Basin (System I)

(k) Effluent Manhole (System I)

(l) Main Lift Station Wet Well and Valve Vault (System J)

B. No painting is necessary on the following:

1. Aluminum hardware, fixtures, casework, finish hardware, etc.
2. Pre-painted or pre-finished electric control panels, disconnects, switch plates, etc.
3. Stainless steel surfaces.

C. Color Schedule:

1. Contractor shall paint and label process piping as shown in the following color schedule:

Piping System Designation	Fluid	Paint Color
A	Aeration Air	Green
AL	Alum	--
C	Supplemental Carbon	White
CA	Compressed Air	Green
CG	Compressed Gas	Green
CS	Chlorine Solution	Yellow
FC	Ferric Chloride	Green w/Orange Band
FR	Fermenter Feed	Light Gray
GS	Grit Separation	Light Gray
HS	Heavy Sludge	--
HW	Hot Water	Blue w/6” Red Band @ 30” Spacing
MLR	Anoxic and Mixed Liquor Return	Light Gray
NG	Natural Gas	Light Orange
OF	Overflow	Light Brown
PD	Plant Drain	Black
P	Polymer	Orange w/Green Band
PP	Process Piping	Light Gray
PW	Potable Water	Blue
RAS	Return Activated Sludge	Dark Brown
S	Sample	--
SC	Scum	Dark Brown
SN	Supernatant	Light Brown
ST	Sludge Transfer	Dark Brown
UW	Utility Water (Non-Potable)	Dark Gray
WAS	Waste Activated Sludge	Dark Brown

2. Any change in the piping color schedules by the Engineer or OWNER shall be at no additional cost.
3. Flow direction arrow shall be painted on all exposed process piping. The size and color of the arrow shall be determined by the ENGINEER.
4. All other piping not listed above shall be painted as directed by the ENGINEER.

D. Paint and paint products shall be supplied according to the following application schedule. Tnemec and Sherwin Williams products are listed as standard. Other equivalent products will be subject to prior approval.

Material or Surface to be Painted	Coats	Tnemec Coatings	Sherwin Williams	Coating Thickness mils (minimum dry)
SYSTEM A				
Ferrous metals not in contact with water including steel, ductile iron, and cast iron (galvanized items omit primer and apply only 3rd and finish coats). Doors and frames reduce total thickness to 5 to 7 mil DFT.	1st Prime Coat	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	4 mils
	2nd Primer	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	4 mils
	Touch-up	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	--
	3rd Coat	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	4 mils
	Interior 4th Finish Coat	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	4 mils
	Exterior 4th Finish Coat	1095 Endura Shield	Acrolon Ultra	2 mils
Surface Prep: P4. Subsequent Coats: Surface to be clean and dry.				TOTAL Interior: 16 mils TOTAL Exterior: 14 mils
Note: All exposed pipe threads and annular space between pipe flange and pipe shall be stripe coated prior to painting.				
SYSTEM B				
Items above when covered by masonry or made inaccessible by construction.	1st Prime Coat Primer (Shop Primer)	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	3 mils
	2nd Touch-Up Prime Coat	46H-413 HB Tneme-Tar	Hi-Mil Sher-Tar	16 mils
Surface Prep.: P4.				TOTAL: 19 mils
SYSTEM C				
Ferrous metals that are submerged, within 1 foot of the water surface, or are in contact with water or digester gases (galvanized and stainless steel clarifier equipment does not require painting).	1st Prime Coat	Factory Finished 46H-413 HB	Macropoxy 646 FCE	3 mils
	Finish Coat	Tneme-Tar	Hi-Mil Sher-Tar Epoxy	16 mils
Surface Prep.: P6				TOTAL: 19 mils

Material or Surface to be Painted	Coats	Tnemec Coatings	Sherwin Williams	Coating Thickness mils (minimum dry)
SYSTEM D				
Factory Finished Equipment Surface Prep.: P1 or as directed.	1st Prime Coat by Factory	N69F Hi-Build Epoxoline II	PFT Copoxy Shop Primer	3 mils
	Touch up	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	4 mils
	*2nd Coat	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	4 mils
	Interior Finish Coat	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	2 mils
	*Exterior Finish Coat	1095 Endura Shield	Acrolon Ultra	TOTAL Interior: 11 mils TOTAL Exterior: 9 mils
*2nd Coat to be approximately the same color as Exterior Metal finish coat.				
SYSTEM E				
Dry Wall, Canvas Pipe Cover or Insulation; PVC and FRP Pipe. Surface Prep.: Clean & Dry	1st Coat	Series 1026 Enduratone	DTM Primer-Finish	2-1/2 mils
	2nd Coat	Series 1026 Enduratone	DTM Acrylic Coating	2-1/2 mils
				TOTAL: 5 mils
SYSTEM F				
Ferrous metal, High Temperature (i.e., aeration piping, muffler exhaust stacks, etc.)	1st Coat	39-1061 Highland International 807 Series Silicone Aluminum	Kem Hi-Temp	1 mil
	2nd Coat	39-1061 Highland International 807 Series Silicone Aluminum	Kem Hi-Temp	2 mils
Surface Prep.: P6				TOTAL: 3 mils
SYSTEM G				
Interior Precast Concrete, Cast-in-Place Concrete, and Concrete Masonry Units (Non-Submerged Interior Walls and Ceilings).	1st Surface	1254 Epoxoblock WB	Kem Cat-Coat Filler	(75-150 sf/gal) 4 mils
	2nd Coat (Spray and Back roll)	N69F Hi-Build Epoxoline II	Macropoxy FCE	4 mils
	3rd Finish Coat (Spray)	N69F Hi-Build Epoxoline II	Macropoxy FCE	4 mils
Surface Prep.: Clean & dry. Mortar cured. Level fins and protrusions.				TOTAL: 12 mils

Material or Surface to be Painted	Coats	Tnemec Coatings	Sherwin Williams	Coating Thickness mils (minimum dry)
SYSTEM H				
Submerged Concrete (Interior of all wastewater and sludge tanks*, Channels, Splitter Boxes, and Anaerobic Digesters).	Finish Coat	46H-413 Tnemec-Tar Tar Epoxy	Hi-Mil Sher-Tar Epoxy	16 mils
Surface Prep.: P14.				TOTAL: 16 mils
SYSTEM I				
Clarifier Effluent Launders (clear or color, as directed)	1st Coat	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	4 mils
	2nd Coat	N69F Hi-Build Epoxoline II	Macropoxy 646 FCE	4 mils
Surface Prep.: P5				TOTAL: 8 mils
SYSTEM J				
Interior of supernatant boxes, supernatant manholes, sludge transfer boxes.	1st Coat 2nd Coat 3rd Coat 4th Coat	Tnemec 120-5002 or equal 120-5003 Filler & Surfaces or equal 120-5002 (Beige) or equal 120-5001 (Gray) or equal	Magnalux 1200 Second coat Magnalux 2100FF Third Coat Magnalux 2500WX Filler & Fairing Putty for smooth transitioning: Magnalux 1500PF	4 mils Trowel apply 20 mils 10 mils Up to 2 inches
Surface Prep.: P14				TOTAL: 34 mils
SYSTEM K				
Exterior Concrete and Masonry	Primer Split-Face and Split fluted only	Series 130 Envirofill		100 sf/gallon
	1st Coat	Series 180 WB Tneme-Crete	Conflex XL Smooth	7 mils
	2nd Coat	Series 180 WB Tneme-Crete (Use 181 WB if sand texture is required)	Conflex XL Texture	7 mils
Surface Prep: P10				TOTAL: 14 mils
SYSTEM L				
Interior of building. Concrete floors and steps.	1st Coat	Series N69 Epoxy	Macropoxy 646 FCE	3 mils
	2nd Coat	Series N69 Epoxy Broadcast w/Silica	Macropoxy 646 FCE Broadcast w/Silica	3 mils
Surface Prep.: Clean & dry. Scarify surface to P5 equivalence.				TOTAL: 6 mils

Material or Surface to be Painted	Coats	Tnemec Coatings	Sherwin Williams	Coating Thickness mils (minimum dry)
SYSTEM M				
Chemical Rooms – Floors and Concrete Containment Floors and Walls.	Prime Coat	--	Corobond Vinyl Ester Primer	3.5 mils
	1st Coat	Series Vinester 120-5002	Cor-Cote VEN FF	12 mils
	Filler	Series 215 Surfacing Epoxy	Poly-Glass Polyester	--
	2nd Coat	Series Vinester 120-5001	Cor-Cote VEN FF	12 mils
Surface Preparation: P10				TOTAL: 24 mils
SYSTEM N				
Unpainted Exterior Block or Brick	1st Coat	Series 633 Prime-A-Pell H2O	H&C HB-100 or HB-150	3 mils
	2nd Coat	Series 633 Prime-A-Pell H2O	H&C HB-100 or HB-150	3 mils
Surface Prep: P10				TOTAL: 6 mils
SYSTEM O				
Concrete Floors (gray color)	2 Coats	Series 237 Power-Tread	--	200 sf/gallon
SYSTEM P				
Concrete Sealer(clear finish)	2-3 Coats	Series 237 Power-Tread	H&C^{R} Silicone Acrylic Concrete Sealer	200 sf/gallon

3.9 ALUMINUM IN CONTACT WITH DISSIMILAR MATERIALS OR CONCRETE

A. Where the aluminum alloy parts are in contact with or are fastened to concrete, steel members, or other dissimilar materials, the aluminum shall be kept from direct contact with materials, the aluminum shall be kept from direct contact with the steel or other dissimilar material by painting as follows:

1. Aluminum surfaces to be placed in contact with steel shall be given one coat of zinc chromate primer or polyamide epoxy in accordance with Federal Specification TT-P-645 or the equivalent, or one coat of a suitable non-hardening joint compound capable of excluding moisture from the joint during prolonged service. Where severe corrosion conditions are expected additional protection can be obtained by applying the joint compound in addition to the zinc chromate primer. Paint shall be allowed to dry hard (air dry 24 hours) before assembling the parts. The steel surfaces to be placed in contact with aluminum shall be painted with good quality priming paint, such as zinc chromate or polyamide epoxy primer in accordance with Federal Specification TT-P-645, followed by one coat of paint consisting of 2 pounds of aluminum paste pigment (ASTM Specification D96266, Type 2, TT-V-8ad, Type II, or the equivalent. Stainless steel or aluminized, hot-dip galvanized, or electro-galvanized steel, placed in contact with aluminum need not be painted.

2. Aluminum surfaces to be placed in contact with wood, concrete, or masonry construction, except where the aluminum is to be embedded in concrete, shall be given a heavy coat of an alkali-resistant bituminous paint before installation. The bituminous paint used shall meet the

requirements of United States Military Specification MIL-P-6883. The paint shall be applied as it is received from the manufacturer without the addition of any thinner.

3. Aluminum surfaces to be embedded in concrete need not be painted, unless corrosive components are added to the concrete or unless the concrete is subjected for extended periods to extremely corrosive conditions. In such cases, aluminum surfaces shall be given one coat of suitable quality paint, such as zinc chromate primer conforming to Federal Specification TT-P-645 or equivalent, or shall be wrapped with a suitable plastic tape applied in such a manner as to provide adequate protection at the overlap.

4. Water that comes in contact with aluminum after first running over a heavy metal such as copper may contain trace quantities of the dissimilar metal or its corrosion product, which will cause corrosion of the aluminum. Protection shall be obtained by painting or plastic coating the dissimilar metal or by designing the structure so that the drainage from the dissimilar metal is diverted away from the aluminum.

B. Exterior Surfaces - All steel surfaces to be sandblast cleaned to SP-6 commercial blast cleaning and factory coated. Edges to be field welded shall be masked three inches wide. Finish coat (to be selected by Engineer/OWNER shall be applied after assembly.

****END OF SECTION****

SECTION 10 14 00 - IDENTIFYING DEVICES

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install all signs and other identifying devices and all appurtenant work in accordance with the requirements of the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall provide shop drawings of all signs in accordance with the requirements in Section 01 33 00 “Submittals.”

B. **Samples:** The CONTRACTOR shall submit to the ENGINEER for approval samples of all materials and colors he proposes to use. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions. All sample submittals shall conform to the requirements for “Samples” in Section 01 33 00.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All items of equipment shall not be delivered to the job until all other finishing operations are complete. After installation, the finish shall be protected from any damage until final acceptance by the OWNER. The CONTRACTOR shall replace at his expense any item of equipment damaged by any workmen before final acceptance by the OWNER.

PART 2 -- PRODUCTS

2.1 INTERIOR SIGNS

A. Signs shall be .125# acrylic plastic with a satin-matte finish and integral permanent color. Signs shall be 2” high minimum and length as required for the graphic, with an 8” minimum. Signs shall be unframed plaques with radius corners.

B. Graphic shall be hot-stamp imprinted on the front surface. Letter style shall be Helvetica medium, capitals, and lower case copy. Provide the following signage to be located as directed by the ENGINEER.

Sign Legend	Minimum Size	Color Letter/ Background	Number Required
Danger Chlorine Gas	As required	Black/Yellow	2
No Smoking	As required	Red/White	3
Hearing Protection Required	As required	Black/Orange	1
Follow Confined Space Entry Procedure	As required	Black/Orange	3
Water Not for Drinking	As required	Black/Yellow	5

C. All non-potable water line outlets shall be identified by an engraved plastic sign permanently affixed to the wall next to the water outlet indicating the water is “NON-POTABLE/ NOT SUITABLE FOR CONSUMPTION”.

D. All chemical storage rooms shall be provided with door signs identifying chemicals, including the SDS pictorial diagram.

2.2 PLAQUE

A. Furnish and install a bronze plaque. The approximate size shall be 24” wide x 18” high with a single line border, pebble textured background, Helvetica letters, polished letters and border, concealed mounting, and spray-on lacquer finish. Plaques manufactured by Champion Ornamental Casting, Inc., or equal.

B. The plaque will contain the following information:

1. Year of construction
2. Name of facility
3. Name of each Council member, including Mayor(10 maximum) and titles
4. Name of City Administrator
5. Name of Public Works Director
6. Name and address of Consulting Engineer
7. Name and address of General Contractor

2.3 VALVE TAGS

A. Furnish brass valve tags for all exposed process valves size 1/2” or larger. Tags to consist of 2” round, black-filled with the numbering of valves as indicated on the plans. Tags to be attached to valve operators or bodies with brass jack chain.

2.4 PIPE LABELS ON WALLS

A. An acrylic plastic sign shall be attached to the wall at the point that each pipe passes through a wall. Signs shall be white with black lettering.

B. ENGINEER will provide engraving legend. Information on signs will include a description of the piping system and piping connection point.

2.5 PIPE LABELS

A. Piping shall be labeled as specified in Section 09 91 00.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Signs and plaques shall be installed in a rigid and substantial manner, with all lines straight and plumb. Finished surfaces shall be cleaned and left free from imperfections. All items shall be installed in strict accordance with the manufacturer's published instructions and recommendations.

B. Valve tags shall be installed so as not to interfere with valve operation.

**** END OF SECTION ****

SECTION 10 40 00 - SAFETY DEVICES

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install all fire extinguishers and smoke detectors indicated in the drawings and described in these specifications.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

1. International Fire Code.
2. National Fire Protection Association (NFPA) Pamphlet No. 10.

1.3 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01 33 00 “Submittals”.

B. **Literature:** Manufacturer's literature, installation instructions, and details shall be submitted.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** All items of equipment shall not be delivered to the job site until all other finishing operations are complete. Equipment shall be delivered in unopened containers. After installation, the finish will be protected from any damage until final acceptance by the OWNER. The CONTRACTOR shall replace at his expense any item of equipment damaged by any workmen before the final acceptance by the OWNER.

PART 2 -- PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Material

1. **Fire Extinguisher - Type I:** Type A extinguisher shall be 20 lb. minimum capacity, A.B.C. dry chemical type with minimum UL rating of 10A:60BC. No. of units required: per regulative authority. For bidding purposes, provide 2 units.
2. **Fire Extinguisher - Type III:** Type C extinguisher shall be 15 lb. CO_2 gas type with a minimum UL rating of 10BC. No. of units required: per regulative authority. For bidding purposes, provide 2 units.
3. **Bracket:** Mounting brackets shall be specially designed for the extinguisher.
4. **Other Materials:** All other materials not specifically described but required for a complete and proper installation of firefighting devices shall be as selected by the CONTRACTOR subject to the review of the ENGINEER.

B. Manufacturers or Equal:

1. J.L. Industries
2. Ansul
3. Amerex Corporation

2.2 HEARING PROTECTOR

A. Furnish two foam-filled vinyl ear cushion-type hearing protectors. The minimum Noise Reduction Rate (NRR) shall be 23 dB.

2.3 BUOYANT VESTS

A. Furnish two (2) adult water safety vests. The vests shall have a four-buckle front. U.S. Coast Guard-approved.

2.4 SAFETY RINGS

A. Furnish one (1) safety ring for attachment at the aeration basin railing, along with 50 feet of 1/2" nylon. U.S. Coast Guard-approved.

2.5 SAFETY POLE

A. Furnish one (1) standard water rescue safety pole.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Install all firefighting devices where indicated in the drawings or as directed by the ENGINEER and in full accordance with all pertinent regulations and manufacturer's recommendations.

B. Top of the fire extinguisher cabinets shall be set no more than five feet above the finish floor.

C. All components shall be anchored firmly in place for long life under hard use.

D. All devices which are not installed shall be delivered for storage.

3.2 SERVICE

A. Just prior to substantial completion date, inspect, charge and tag the fire extinguishers.

**** END OF SECTION ****

SECTION 11 53 00 - LABORATORY EQUIPMENT (ALLOWANCE)

PART 1 -- GENERAL

1.1 SCOPE

A. Material and equipment described in this section shall be purchased with the Laboratory Allowance provided in Section 01 21 00 - Allowances, Owner or Engineer to provide updated list prior to procurement.

B. The laboratory shall be fully equipped with chemicals, glassware, and apparatus required to conduct the following tests in accordance with the current edition of Standard Methods for the Examination of Water and Wastewater.

- Dissolved Oxygen (D.O. Meter)
- Chlorine (DPD)
- pH
- Residue total filterable and non-filterable solids
- Nitrogen, all forms w/Hach TNT test kits
- Miscellaneous Items

C. Contractor shall receive and install all equipment purchased with the laboratory allowance or identified in this Section.

1.2 DESCRIPTION OF EQUIPMENT

A. Sample Holding

1. Refrigerators

(a) 23” W x 22-7/16” D x 34-1/2” H heavy-duty under counter type, 6.1 cu. ft. minimum capacity, 35-43 degrees F operating temperature range, two removable adjustable shelves, door hinged on left or right, front air intake and exhaust, suitable for 115 volts, 60 Hertz electrical service. Non-frost-free, furnish with a thermometer. Provide two (2) refrigerators.

2. Temperature Regulator

(a) To convert a manually-defrosting refrigerator into a 20°C incubator, the temperature regulator shall combine both an internal heater and a built-in temperature sensor for controlling electrical power to the refrigerator being supplied. The temperature regulator shall have a circulating fan to maintain a uniform temperature throughout the compartment. The temperature regulator shall not occupy more than 0.11 feet of refrigerator space and shall be installed in the refrigerator to make a complete operational incubator. The temperature regulator shall be Fisher Isotemp, or equal. One (1) of the refrigerators from A.1. above shall be converted.

B. Dissolved Oxygen (D.O. Meter)

1. Dissolved Oxygen Meter

(a) Designed for D.O. and temperature measurement in the laboratory or in the field. Digital readout shall be in parts per million, dual-range, with 0.1 or 0.01 mg/l resolution, accurate to +/- 0.03 mg/l for 0-20 mg/l, +/- 0.3% for 0 to 200%, and +/- 0.3 degrees C for -5 degrees to +45 degrees C. Automatic temperature compensation. Housed in a water-resistant ABS case.

The power supply shall be four “D” size rechargeable batteries or 120 volts A.C. The meter shall be YSI Model 58 or equal.

(b) Unit shall be furnished with:

- 1 - Self-stirring BOD bottle probe, YSI Model 5905
- 1 - Oxygen/temperature field probe, YSI Model 5739.
- 1 - Membrane/KCl kit, YSI Model 5775.
- 1 - Detachable Cable (10'), YSI Model 5740-10.
- 2 - Membrane Cap Kit, YSI Model 5731.

C. Chlorine (DPD)

1. Dual range chlorine test kit, Hach Digital Pocket Colorimeter - Hach Model 46700-00; range 0.02 mg/l to 2.0 mg/l free and total chlorine. DPD method of analysis, using unit-dose chemical pillows. Kit to include pillows for 300 tests on free chlorine and 300 tests for total chlorine and shall be contained in a portable carrying case.

D. Miscellaneous Test

1. Microscope

(a) Inclined reversible binocular body, 1x apochromatic objective, 15x wide field eyepieces. Magnifications 4x, 10x, and 40x at 10 cm working distance. Rack and pinion coarse and fine focusing mechanisms. Supply with detachable transilluminating substage base with tilting mirror. The illuminator shall be a 6.5 V, 20 W tungsten lamp with an external swivel stand and shall be mountable directly on the microscope body. Microscope complete with dust cover and illuminator with 120 volts, 3-prong plug, cord, transformer, switch, and with mechanical stage, Fisher Micromaster II Cat. No. 12-561-4B or equal.

E. Residue

1. Portable Combination Pressure/Vacuum Pumps

(a) Pressure/vacuum type, 1725 rpm, 1/6 H.P. ball bearing motor-driven, with gauges, regulators, and carrying handle. Capable of producing pressures up to 25 psi (intermittent service), 15 psi (continuous service), and vacuum of 27 inches Hg. Minimum free air displacement of 1.8 cfm. Intake filter with 10 um element. Suitable for 115 volts, 60 Hertz electrical service.

2. Analytical Balance

(a) Single bar controls for automatic taring, integration time selection, and calibration. Three-way access to the weighing chamber through sliding glass doors. Taring range from 0 to 200 g. Readability 0.1 mg. Precision 0.1 mg. Linearity + 0.2 mg. Stabilization time 5 seconds. Variable integration time 1.5/3/6 sec. Pan size 9.0 cm diameter. 110 volt, 60 Hz. Ohaus equal.

3. Oven

(a) 11-1/2” deep x 10-1/2” wide x 10” high, approximate inside dimensions. A minimum capacity of 0.7 ft. 534, welded steel construction. Two nickel-plated adjustable shelves. Hydraulic thermostat, adjustable vents. Pilot light to indicate heater action, 220°C mercury thermometer. 115-volt AC, 60 Hertz, variable temperature control from 30°C to 200°C.

F. pH

1. Hach one pH/ISE Meter Model 51775-10. Furnish one (1) spare pH electrode Hach Model 44200-21.

G. Spectrophotometer

1. Furnish one (1) Hach Model DR/3900 Spectrophotometer.
2. Reagent sets
   (a) Ortho Phosphate (PhosVer 3 Ascorbic Acid)
   (b) Total Phosphorus (PhosVer 3 Test-n-Tube)
   (c) Nitrogen, Ammonia Salicylate Method High Range 0.4 to 50 mg/l as NH_3-N

H. Miscellaneous Items

1. Water Core Sampler
   (a) Water core sampler for clarifier sludge blanket determination, 20 feet long, clear rigid polycarbonate tubing with sleeve joint and clamps for easy assembly, rope handle, numbered at one-foot intervals, floating check valve operation; Nasco, Raven, or equal. Provide two (2) units.
2. Settleometer
   (a) The all-plastic kit consists of a 2-liter, wide-mouth polycarbonate settleometer jar with white graduations, polypropylene paddle, cover, instruction booklet, and datasheet. All components are chemical resistant to normal sludge samples (pH range 3 to 10). Jar dimensions: 13 cm diameter x 19 cm H. Provide four (4) kits.
3. Benchtop Centrifuge
   (a) Centrifuge with swing (horizontal) rotor and shields. Continuously adjustable speeds up to 5100 RPM. Creates a relative centrifugal force (RCF) of 3400 x G. 30-minute adjustable time with one-minute division. A Solids-State speed controller and electronic brake. Guard bowl shall be formed from a single piece of chemical-resistant polyethylene. The base shall be constructed of cast iron. Fisher centrifuge Model 225 or equal. Six-place rotor to include permanently attached trunnion rings. Shields shall be capable of holding 15 ml centrifuge tubes. Supply 6 shields for the rotor.
4. First Aid Kit
   (a) Wall-mount kit similar to Fisher Model 10-020, Curtis Mathison 121-152, or equal.
5. Eye Wash Shower
   (a) Hose spray fittings 6' long rubber hose, squeeze lever operation. Shall be placed near the sink so that sink may serve as a drain.

1.3 MISCELLANEOUS APPURTENANCES

Quantity	Description
1	Bags, Plastic, Waterproof, Pk. 500 Whirl-Pak Sample Bags
12	Beaker, Pyrex, 150 ml
12	Beaker, Pyrex 250 ml
2	Beaker, Pyrex 1000 ml
24	Poly BOD Bottle Caps

Quantity	Description
4	Bottle, Wash 16 oz
12	Bottle, Poly, 1000 ml wide mouth with Cap
	1,000 ml, Glass Stopper
	Brush, Burette
1	Brush, Cylinder
1	Brush, Flask
1	Buchner Funnel, 2-Piece Polypropylene with Perforated Plate, 110 mm Diameter with Rubber Stopper to Fit 1000 ml flask
2	Carboy, Poly-Prop, 2 Gal.
2	Carboy, Rectangular, Spigot, 5 gals. Polypropylene
12	Clamp, Pinchcock, Polypropylene
2	Cylinder, Graduated, 50 ml, Glass
2	Cylinder, Graduated, 50 ml, Polypropylene
2	Cylinder, Graduated, 100 ml, Glass
2	Cylinder, Graduated, 100 ml, Polypropylene
1	Cylinder, Graduated, 250 ml, Glass
2	Cylinder, Graduated, 250 ml, Polypropylene
2	Cylinder, Graduated, 500 ml, Polypropylene
2	Cylinder, Graduated, 1000 ml, Polypropylene
2	Filter, Glass Fiber, 4.7 cm, 1.2 Micron Package of 100
2	Filter, 11 cm, 1.2 Micron, Glass Fiber, Package of 100
1	144 Plain Glass Micro-Slide
1	200 Plaster Cover Slips
1	Filter Holder, Polypropylene, Consisting of Funnel, Graduated to 300 ml, Magnetic Locking Ring Mechanism, and Rubber Stopper
3	Flasks, Erlenmeyer, 500 ml, Glass
2	Flasks, Filtering, 1,000 ml, Polypropylene
3	Forceps, Stainless Steel, Self-Closing Offset Tipped
1	Funnel, Glass, 100 mm, Short Stem
6	Pair, Gloves, Rubber
1	Pair, Gloves, Asbestos
1	Imhoff Cones, Bench Rack, 3 Places
1	Parafilm, Clear, Grade M, 4” x 250 feet
12	Pipette, Measuring, 5 ml, Large Opening
12	Pipette, Measuring, 10 ml, Large Opening
12	Pipette, Measuring, 25 ml x 0.1 ml, Large Opening
1	Pipette Storage Rack, Polypropylene
1	Polypropylene Drying Rack with Drain Tube Connection
3	3-Valved Safety Pipette Bulbs
3	8 Bottle Storage Racks for BOD Bottles
2	Safety Glasses
12	Stirring Bars

Quantity	Description
2	Stirring Bar, Retriever
1	Thermometers, -20° to 110°C
1	Thermometer, -20 to 100°C with Metal Armor Case
2	Tongs, Stainless Steel 9” (22.9) cm), Crucible
2	Tubing, 10', Pressure-Vacuum, Tygon Flonum R-3603 1/4”
1	Clear Plastic Tubing Inside Dia. 1/4” outside 3/8” 50'
1	Nalgene Autoclavable, Plastic Desiccator 250 mm diameter
1	Nalgene Metal Desiccator Plate, 240 mm diameter
1	Weighing Pans, 100 PK. 5 cm
1	Latest Edition of Standard Methods for the Examination of Water & Wastewater

1.4 DESCRIPTION OF CHEMICALS

Quantity	Description
1	Buffer, Reference, pH 4, 16 oz.
2	Buffer, Reference, pH 7, 16 oz.
1	Buffer, Reference, pH 10, 16 oz.
1	Cleaning Compound, 4 liters, CMS Control 70, or equal
1	Drierite, 8 Mesh, Indicating Type, 1 lb.
1	Nitrification Inhibitor, Hach or equal
1	Sulfuric Acid Concentrate, 500 ml
1	Box of Detergent, Alconox

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

**** END OF SECTION ****

SECTION 12 50 00 - FURNISHINGS (ALLOWANCE)

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. This Section includes furnishing and installing office furniture, appliances, and other equipment, as shown on the plans or directed by Engineer.

B. Materials to be furnished under this Section will be paid for under the allowance established in Section 01 21 00 - Allowances.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Section 01 60 00.

PART 2 -- PRODUCTS

2.1 SCHEDULE OF PRODUCTS

A. Office furniture - desks, chairs, cabinets.

B. Other items as identified by Owner or Engineer.

PART 3 -- EXECUTION

3.1 EXECUTION

A. Verify that building conditions are ready to receive work.

3.2 INSTALLATION

A. Install fixtures, accessories, and items in accordance with manufacturers' instructions.

B. Provide complete installation including all accessories, spacers, connectors, wires, and any other materials necessary to provide fully operational instructions.

C. Remove all shipping materials (from the site) and clean furnishings.

D. Verify the final location of furnishings with the architect.

E. Installer is responsible for coordination with the Owner and other trades.

F. Installer is responsible for any building cleaning or damage repair caused by installation.

**** END OF SECTION ****

SECTION 13 34 13 – GLASS FIBER REINFORCED PLASTIC TANK COVERS

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The work included in this section consists of furnishing all labor, materials, and equipment to completely design, fabricate, and erect the following flat or arch style clear span dome-type weather covers:

1. Spring Valley WWTF Storage / Decant Tank No. 1
2. Spring Valley WWTF Storage / Decant Tank No. 2

B. All materials used in the construction of the domes shall be capable of withstanding continuous exposure to the condensates, gases, or other corrosive elements which may be present in the wastewater treatment process units.

C. The thickness of the wall of various treatments is as shown in the drawings. The cover shall be self-supporting from the periphery without interior supports.

D. Except as specified otherwise herein, the provisions of the International Building Code shall govern.

E. Cover components include the following:

1. Glass fiber reinforced plastic (FRP/GRP) tank cover.
2. Glass fiber reinforced plastic (FRP/GRP) structural supports.
3. Flashing and trim.
4. Fasteners and anchors.
5. Gaskets.
6. Accessories and appurtenances.

1.2 RELATED SECTIONS

A. Section 01 33 00 - Submittals

B. Section 05 50 00 - Miscellaneous Metals

C. Section 46 51 52 - Coarse Bubble Mixing System

1.3 REFERENCES

A. ASTM D638, Standard Test Method for Tensile Properties of Plastics

B. ASTM D790, Standard Test Method for Flexural Properties of Plastics

C. ASTM D695, Standard Test Method for Compressive Strength of Plastics

D. ASTM E84, Standard Test Method for Surface Burning Characteristics of Plastics

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 – Submittals.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Calculations, design data, and test reports as applicable, indicating compliance with requirements.
2. Storage and handling instructions.
3. Installation instructions.

C. Drawings including layouts, product description, connection and framing details, fastener types, and spacing.

D. Miscellaneous certifications.

1.5 QUALITY ASSURANCE

A. Tank cover supplier shall manufacture and fabricate all FRP components in its own facility, which must be ISO 9001 certified.

B. Tank cover manufacturer shall have completed a minimum of ten (10) projects of a similar type as required in this scope within the last five years.

C. Contractor shall verify all field dimensions for the development of the manufacturer's drawings.

D. Contractor shall review and confirm in writing the approval of the manufacturer's drawings.

1.6 PRODUCT SUBSTITUTIONS

A. Substitutions shall be considered if the Engineer has received a written request at least two weeks prior to the bid date. If substitutions are acceptable, bidders shall be notified by addendum.

B. Requests for substitutions shall include technical information, including but not limited to, air leakage test report and structural performance data.

1.7 PERFORMANCE TESTING

A. Materials shall comply with Federal and Local laws or ordinances, applicable codes, standards, regulations, and/or regulatory agency requirements.

B. Structural framing and deck panels shall meet performance and design criteria listed herein for span conditions indicated on drawings. Individual units shall demonstrate compliance with design criteria by large-scale testing.

1. FRP Deck Panels: Uniform Load and Deflection Test
2. FRP Structural Components: 3 Point Load Bending Test

C. Air Leakage

1. Air leakage shall not exceed .2 CFM/SF at a negative pressure of .2 inches of water column for a 5-minute duration per Air Leakage Test in accordance with Procedural Standards for Adjusting and Balancing Environmental Systems.
2. Testing shall be conducted by an independent test agency certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).

1.8 DESIGN CRITERIA

A. Design for applicable load and combinations of loads in accordance with the specified building code as noted in the structural notes on drawing Sheet 3.01. Design loads shall be combined to produce maximum stresses within the structure in accordance with the specified building code. Submit shop drawings and calculations certified by a professional engineer registered in the State of Minnesota.

1. Design Risk Category III

2. Wind Design Data:

(a) Basic Wind Speed: V = 120 mph (ultimate)

(b) Wind Exposure C

(c) Internal Pressure Coefficient: GCpi = +/- 0.18

3. Roof Snow Load Data:

(a) Ground Snow: P_g = 50 psf

(b) Flat Roof Snow: P_f = 46.2 psf

(c) Importance Factor: I_s = 1.1

(d) Exposure Factor: C_e = 1.0

(e) Thermal Factor: C_t = 1.2

B. Personnel Load: Flat covers shall be capable of supporting a 300 lb. concentrated load over a 30” x 30” area located at the panel midspan with L/240 deflection limit or deflection not exceeding 5/8”.

C. Cover Panel Removability:

1. Each cover panel shall be removable without having to remove any adjacent cover panel.

2. Each cover panel shall be removable vertically and without cutting a cover component.

D. Slip Resistance for Flat Cover Designs

1. Cover panels, end-to-end joint flashing, and side-joint, locking channel shall utilize TreadMAX™ integral, non-skid surface technology or meet the following criteria:

(a) The cover shall have a slip-resistant walking surface designed for operator foot traffic.

(b) Non-skid surface shall be an integral (embedded) part of the cover panel and not achieved by use of coatings/paint, adhesive tapes, or other applied product after the manufacturing process.

(c) Slip resistance tread shall be, at a minimum, bi-directional.

2. Minimum average Dynamic Coefficient of Friction (DCOF) shall be 0.50 per ANSI A137.1/A326.3 Dynamic Coefficient of Friction Test.

3. Minimum wet Pendulum Test Value (PTV) shall be 45, with a Four S (96) hard rubber slider, per AS HB198:2014 (AS/NZS 4586) Pendulum Test.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS, OR EQUAL

A. Enduro Composites

B. Strongwell

C. Midwestern Fabricators

2.2 MATERIALS

A. Fiberglass reinforced plastic (FRP) structural components, including cover panels, beams, and framing, shall be manufactured by the pultrusion process. Contact-molded or hand-laid-up fiberglass materials shall not be acceptable as structural components.

B. Tank Cover

1. Resin type for FRP tank cover decking shall be UV stabilized, Isophthalic Polyester or Vinyl Ester. Orthophthalic polyester (general purpose) is not acceptable.

2. Materials shall be fire-retardant and have a flame spread rating of 25 or less per ASTM E84.

3. Materials shall exhibit these Physical Properties (at a minimum):

(a)	Tensile Strength	26,500 psi	ASTM D 638
(b)	Flexural Strength	30,000 psi	ASTM D 790
(c)	Flexural Modulus	1,550,000 psi	ASTM D 790
(d)	Compressive Strength	30,000 psi	ASTM D 695
(e)	Shear Strength	23,000 psi	ASTE D-732
(f)	Izod Impact (Notched)	20	ASTM D 256
(g)	Water Absorption	.20% max	ASTM D 570
(h)	Glass Content	45% by weight	

4. Cover panels shall be sealed at side-laps with an EPDM gasket. Side-lap gaskets shall be factory-installed and oriented vertically so they are compressed when the locking channel is placed into position.

5. Cover panels shall utilize TreadMAX™ non-skid surface technology. No coatings/paints, adhesive tapes, or other applied products after the manufacturing process shall be allowed.

6. Color of deck panels shall be standard gray.

C. Access Hatches

1. Access hatches shall be raised or flat with a one-leaf hatch door and fabricated from pultruded fiberglass components.

2. Access hatches and framing shall be removable without affecting adjacent panels.

3. Underside of raised hatch lids shall be sealed with factory-installed, 3/8” diameter neoprene bulb gasket. Perimeter hatch curb shall be sealed to decking surface with adhesive sealant.

4. Underside of Flat hatch lids shall be sealed with factory-installed, 1/4” EPDM Flat gasket. Perimeter hatch curb shall be sealed to decking surface with adhesive sealant.

5. 36” X 36” size Access Hatches (if required) shall have a stainless steel, gas piston hold-open device. Gas Piston shall be designed to aid in opening and to hold open the hatch once locked in place.
6. Hatch lids shall have a factory-applied non-skid, UV-resistant surface with plastic or stainless steel lift handles.
7. Viewport hatches, if indicated on drawings, shall be 12 inches square or less.

D. FRP Structural Framing

1. Resin type for FRP beams and framing members shall be vinyl ester.
2. Glass fiber reinforcements shall be 50% (min) of the material weight.
3. Structural components shall be fire-retardant with a flame spread rating of 25 or less per ASTM E84.
4. If cover is flush-mounted, ledger angles shall be FRP or 316 stainless steel.
5. All connections for attachment to FRP beams or fastening connections shall be stainless steel angles or plates. Use of FRP for connections shall not be allowed.
   (a) 316 Stainless Steel

E. Trusses: Not required or allowed.

F. Flashing and Trim

1. FRP flashing shall be isophthalic polyester with dimensions and profile as shown on the drawings.
2. Non-radius end flashing shall be factory attached to individual deck panels.
3. Flashing with a radius or at the perimeter of a circular tank shall be a separate part and field attached by the installing contractor.
4. Slide gate flashings (if indicated on drawings) shall be aluminum brush type.

G. Air Vents and Connections

1. FRP gooseneck ventilation piping with bird screen shall be provided by cover manufacturer.
2. FRP stub-vent connections with a blind flange shall be provided by cover manufacturer.
   (a) Connections shall extend at least 6 inches from top of tank cover deck.
3. Tanks contents are aerated at a maximum of 1000 SCFM and may be filled or drained at a maximum rate of 1000 gpm.

H. Pipe Penetrations

1. Existing or new pipe penetrations shall be retrofitted by contractor to penetrate cover at a 90 degree angle.
2. Pipe penetrations shall be flashed in the field with a Sealtite retrofit, zipper-type pipe flashing, or equal as provided by the cover manufacturer.

I. Hardware

1. Fasteners, anchorage, hinges, and other structural accessories located on underside of cover shall be:
   (a) 316 Stainless Steel

2. Perimeter flashing anchors, concrete anchors, or other hardware not exposed to the inside environment of the tank shall be 304 Stainless Steel.

3. Fasteners to attach tank cover decking to structural supports shall be:

   (a) 316 Stainless Steel

J. Gaskets and Sealants

1. All panel side laps and perimeter conditions shall have gaskets.

2. Gaskets under flashing with radius and at the perimeter of circular tanks shall be installed by the contractor.

3. Adhesive sealant shall be applied by the contractor at various locations as required by the manufacturer for odor containment.

PART 3 -- EXECUTION

3.1 MATERIAL HANDLING

A. At the time of delivery, all materials shall be inspected for shipping damage. The freight company and manufacturer shall be notified immediately of any damage or quantity shortages.

B. Contractor shall protect FRP materials from cuts, scratches, gouges, abrasions, and impacts. When lifting FRP materials, spreader bars shall be used (not wire slings unless materials are fully protected). FRP components shall not be dragged across one another unless separated by a non-scratching spacer.

3.2 INSTALLATION

A. Before placing and attaching components, the erector must confirm alignment and location of bearing plates, surfaces, brackets, saddles, etc. All bearing surfaces must be clean and free of debris.

B. Before placing secondary framing members or deck, the erector must check the alignment and location of supports.

C. Erection shall proceed according to the sequence shown on the approved drawings.

D. If applicable, contractor shall install structural members, beam seats, or ledger angles in locations shown on the approved drawings. Contractor shall assemble trusses as required.

E. Position FRP tank cover beams (if applicable) in locations, as shown on the manufacturer's drawings. Field modifications (cuts, copes, holes, etc.) other than work shown on the drawings are not allowed without the manufacturer's written consent.

F. Anchor FRP beams and adjust tank cover components into the final position with proper bearing and alignment at joints, laps, and supports before fastening. Refer to the manufacturer's installation instructions for proper fastener selection, fastener location, driving techniques, and pertinent information for fastening equipment.

G. Starting at the end shown on the manufacturer's drawings, position and place cover deck panels in locations as shown. Field modifications (cuts, copes, holes, etc.) other than work shown on the drawings are not allowed without the manufacturer's written consent.

H. Fasten or anchor FRP cover deck panels into location as shown on the drawings.

I. Place and attach flashing as shown on the drawings.

3.3 WARRANTY

A. The cover manufacturer shall warrant that the work described herein shall be free from defects, workmanship and material. The flat cover manufacturer shall replace, or repair only faulty workmanship or defective material furnished by it that is reported to it within one (1) year from the date of shipment

**** END OF SECTION ****

SECTION 13 34 23 - CIRCULAR TANK COVERS

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The work included in this section consists of furnishing all labor, materials, and equipment to completely design, fabricate, and erect the following clear span dome-type weather covers:

1. Spring Valley WWTF Final Clarifier #1
2. Spring Valley WWTF Final Clarifier #2

B. All materials used in the construction of the domes shall be capable of withstanding continuous exposure to the condensates, gases, or other corrosive elements which may be present in the wastewater treatment process units. The tensile forces present at the periphery of the domes shall be resisted by tension rings designed for that purpose, and no tensile forces shall be transmitted to the supporting concrete walls.

C. The thickness of the wall of various treatments is as shown in the drawings. The covers shall be self-supporting from the periphery without interior supports.

D. Except as specified otherwise herein, the provisions of the International Building Code shall govern.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 05 50 00 - Miscellaneous Metals

C. Section 46 43 21 Clarifier Equipment - Suction Type Clarifier

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ASTM C509	Standard Specification for Cellular Elastomeric Preformed Gasket Sealing Material.
Aluminum Association	Specifications for Aluminum Structures.
AISI	Stainless Steel Cold-Formed Structural Design Manual.
AWWA D-100	Welded Carbon Steel Tanks for Water Storage

B. Codes

International Building Code (IBC)

Minnesota Amendments to IBC

1.4 WARRANTY

A. The domes shall be guaranteed for a period of two (2) years from the date of acceptance against defective material and workmanship.

1.5 SUBMITTALS

A. The dome fabricator-erector shall submit the following to the ENGINEER prior to construction:

1. Drawing showing dimensions, materials, and details of the proposed covers, including anchorage and expansion device to be incorporated into the reinforced concrete tank walls, access dormers with door and frame, tension ring, joint attachment, and erection procedures.

2. A complete stress analysis summary showing the load criteria, maximum stress, and allowable maximum stress.

3. The design calculations shall be certified by a Registered Professional Engineer registered in the State of Minnesota.

B. The dome supplier shall provide evidence of at least 3 years of experience in the fabrication and erection of similar structures. In lieu of experience, the CONTRACTOR may supply a bond of $100,000.

1.6 DESIGN REQUIREMENTS

A. Aluminum domes shall conform to the International Building Code and the Aluminum Association “Specifications for Aluminum Structures” and shall be designed to sustain, within the stress limitations of the Aluminum Association's specifications, the loads specified herein.

B. The dome roof shall be a spherical structure conforming to the specified dimensions. The dome shall be a fully triangulated space frame complete with non-corrugated closure panels. The dome shall be clear-span and designed to be self-supporting from the periphery structure with primary horizontal thrust contained by an integral tension ring.

C. The aluminum closure panels shall be attached continuously along their edges to the structural members by means of clamping bars that engage the panels in an interlocking unit. The clamping bar shall also secure an elastomeric weather seal gasket which shall form a continuous watertight seal along the panel edges.

D. The entire structure shall be designed as a watertight system under all design load conditions. Hub covers shall be flanged and shall not form water damns or puddles. The hub cover should be connected to the hub with one center bolt. Fastening the hub cover to the panel through the flange is prohibited.

E. Primary triangular closure panel fasteners must engage an extruded groove in the supporting beam which is sized in width and depth to develop the full breaking strength of the fastener. In no case will the groove be less than 3/4” deep.

F. Bearings at the supports shall conform with AASHTO Division 2, Section 25. Acceptable bearings surfaces for sliding bearings are Teflon to stainless steel only. In order to avoid damage to the Teflon and to reduce the coefficient of bearing friction, Teflon shall not bear on aluminum surfaces. Supports shall utilize a stainless steel pin in order to accommodate un-level support conditions.

G. In no case shall a joint be designed to sustain a greater total resultant shear force than that which would be allowed by summing the allowable sheer force of the individual fasteners, based on their net cross-sectional area through the shear plane and the allowable shear stress of the material, as summarized below. The use of manufacturer's test data is prohibited. In no case shall values greater than those published by the Aluminum Association and the AISI for aluminum and stainless fasteners, respectively, be used. The allowable stresses are summarized below:

Fastener Material	Allowable Shear Stress
Cold Finished Type 304 Stainless Steel	18 KSI
2024-T4 Anodized Aluminum	16 KSI
7075-T73 Aluminum	17 KSI

H. A minimum of four (4) fasteners per flange will be used to connect the structural members to the gusset plates.

I. No welding of the aluminum structural members, supports, or connections shall be allowed due to its adverse effect on the strength of the aluminum alloys.

J. No design shall be allowed which does not bolt structural member flanges to the gusset plates at the joints.

1.7 DESIGN LOADS

A. The entire dome cover structure shall be designed to sustain the loads specified herein. The load case, the magnitude of the loads, and the proper application of the loads shall all be determined in accordance with the IBC. The structure shall be considered to be a roof and thus specifically subject to the requirements of the IBC, Sections 2305 and 2311, as well as other applicable sections.

B. The dead load shall be defined as the weight of the structure and all material attached to and supported by the structure.

C. The uniform live load shall be assumed to act vertically upon the area of the dome projected upon a horizontal plane. The value of the live load shall be 35 psf. Total uniform live load plus dead load shall be not less than 40 psf.

D. The unbalanced live load shall be 20 psf over one half of the structure, with no live load on the other half.

E. The wind load shall be defined as having two components. One component shall be defined as a horizontal velocity pressure of 25 psf, multiplied by a shape factor as defined by the IBC, acting upon the gross area of the vertical projection of the dome. The other component shall be defined as an up-lift pressure, equal to three-fourths of the unit velocity pressure, which acts normal to the surface of the dome. The design of the roof shall allow for wind from any direction at 100 mph wind speed.

F. Due consideration will be given to the effects of temperature variation acting within a range that is based on local meteorological records. A low temperature of -20 degrees F. and a high temperature of +120 degrees F.

G. In addition to the above-mentioned loads and load combinations, the panels shall be designed for a 250 pounds load distributed over one square foot at any location and a plus or minus 60 PSF load distributed over the entire area of any given panel. These loads are to be taken as acting separately, and not simultaneously with other design loads.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. All bolts and fasteners shall be 316 Stainless steel, 2024-T4 aluminum, or anodized 7075-T73 aluminum.

B. Plate and sheet material shall be mill-finished aluminum alloy 3003-H16, 6061-T6, or 5052-H32. Tension ring hubs shall be 0.375” minimum thickness.

C. Aluminum structural shapes shall be alloy 6061-T6. The aluminum structural members shall be a minimum of 6 inches deep.

D. All gaskets shall be Silicone, resistant to ozone and ultraviolet light, and conform to Federal Specification ZZ-R-765, Class 2, Grade 50 as manufactured by General Electric SE-44/88 or equal.

E. All sealants shall be resistant to ozone and ultraviolet light, and conform with Federal Specification TT-S-00230 as manufactured by Pecora 864 or equal.

F. Dormers, doors, and hatches shall be 6061-T6, 5086-H34, or 5052-H36 aluminum, 0.090" nominal thickness.

G. Finish shall be Aluminum Association M-42/43 grit blasted finish.

2.2 OPENINGS

A. Each cover shall be furnished with a dormer entrance having a 7' minimum vertical clearance and with one 3' wide by 6'-8" high walk-in access door installed at the entrance for each dome as shown in the drawings. This door shall be provided with three 4" x 4" stainless steel ball-bearing hinges and a stainless steel bar type latch. The latch shall be operable from both sides with a provision for a padlock on the exterior. All doors and frames shall be aluminum and shall be of welded construction with doorplates of 1/8" minimum thickness. All frames shall be made of aluminum angles, channels, or plates of adequate size and thickness for rigid support. Doors shall have full-size welded frames, plates, or angles, braced and stiffened to provide adequate support for the doorplates and rigidity to the door. Doors, frames, and all accessories shall be of very substantial construction to provide maintenance-free service, and the material for these items shall be 6061-T6 aluminum or other approved material. The interior face of doors and frames shall be provided with heat tracing to prevent ice build-up due to high humidity within the dome.

B. Ten (10) square feet divided among three separate vent openings will be required in each cover. Vents shall include removable and replaceable 24 mesh stainless steel wire cloth and backdraft dampers set to open on pressure produced by the intake fan. Complete details of the air vents and doors the bidder proposed to furnish shall be included in the shop drawings submitted to the Engineer for approval.

C. Each cover shall have access hatches near the periphery as shown in the drawings.

2.3 INTAKE FANS

A. Each cover shall be furnished with an aluminum belt-drive axial flow intake fan, 1/3 hp, 120 volts, single-phase, 2000 cfm @ 3/8" w.c. The cover manufacturer is to verify the static pressure required for the backdraft dampers supplied. The fan shall be mounted in a duct on the side of the cover opposite the door with a dome-mounted relief hood of corrosion-resistant material. The fan shall be accessible for maintenance from the outside. A louver with removable and replaceable 24 mesh stainless steel wire cloth shall be placed at the inlet. All motors shall be explosion-proof and conform to the electrical code for this type of application.

2.4 MANUFACTURERS OR EQUAL

A. Tank Connection

B. CST Industries

C. Ultraflote

PART 3 -- EXECUTION

3.1 ERECTION

A. All dome elements shall be handled in a manner to avoid damage. Damaged members shall be removed from the site, except when field repair is approved by the Engineer and such repairs are satisfactorily made in accordance with the manufacturer's recommendations.

B. All work shall be performed by mechanics skilled and experienced in the fabrication and erection of the dome material being erected.

C. Separate on/off switches shall be provided for intake fans and lights.

**** END OF SECTION ****

SECTION 21 12 00 - INDUSTRIAL HOSE AND FITTINGS

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install industrial hose and fittings as specified herein.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS OR EQUAL

A. Hose

1. Uniroyal
2. Goodyear

B. Quick Disconnect Couplings

1. Kamlok
2. Ever-tite

C. Universal-Type Couplings

1. Le-Hi
2. Foster

D. Expansion Ring Couplings

1. Akron
2. Elkhart

E. Fog Nozzle

1. W.D. Allen Manufacturing Co.
2. Halprin Supply Co.
3. Arrow

2.2 MATERIALS

A. Hose supplied shall be as follows:

Length/Diameter	Location/Application	Type
15’-6”	Sludge Loadout (Sludge Transfer)	Water Suction (Uniroyal Goodyear Ply-Cord, or equal, w/spiral wire helix)
50’-1 1/2”	Sludge Building (Sludge Line Flushing)	Water Discharge (Uniroyal P-8029, Goodyear Ply-Cord (2-25 foot lengths), or equal
50’-1 1/2”	Process Tank Washing (2-25 foot lengths)	200 psi, Seamless, Extended Rubber with Dacron Cotton Exterior

B. Fittings:

1. 6” Hose - One end with transition coupling to 6” 90 aluminum elbow, and a 6” aluminum male quick-disconnect coupling (compatible with female quick-disconnect coupling located in sludge loadout. The other end with 6” female aluminum quick-disconnect coupling (compatible with sludge applicator side inlet coupling).
2. 1 1/2” Hose - One end with 1 1/2” high-pressure hose connection. The other end with 1 1/2” male universal-type quick-acting hose coupling (compatible with 1 1/2” flushing connections noted on plans and as specified in Section 40 05 60, 3.M.).
3. 1 1/2” Hose - Each hose shall be provided with male and female connectors of brass with a polished finish.
4. A fog nozzle shall be provided and be capable of complete shut-off, shall produce a solid straight stream, and up to a 90-degree conical fog. Nozzle material shall be brass with a polished finish and the nozzle shall have a rubber bumper.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Install hoses and fittings where shown or noted on the plans.

**** END OF SECTION ****

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Sleeves.
6. Mechanical sleeve seals.
7. Equipment bases and supports.

B. Related Sections:
1. Section 22 11 00 - Facility Water Distribution: Execution requirements for placement of hangers and supports specified by this section.
2. Section 22 13 00 - Facility Sanitary Sewerage: Execution requirements for placement of hangers and supports specified by this section.
3. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product and execution requirements for vibration isolators.

1.2 REFERENCES

A. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

1.3 SUBMITTALS

A. NONE.

1.4 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 COORDINATION

A. Coordinate Work with other trades.

PART 2 -- PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Anvil International (Mueller Water Products, Inc.).
2. Carpenter & Paterson Inc.
3. Creative Systems Inc.
4. Flex-Weld, Inc.
5. Globe Pipe Hanger Products Inc.
6. Michigan Hanger Co.
7. Superior Valve Co.

B. Plumbing Piping - DWV:
1. Conform to MSS SP 69.
2. Hangers for Pipe Sizes ½- to 1-½-inch: Malleable iron or Carbon steel, adjustable, clevis.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
10. For Exterior and Humid Areas: Furnished hot-dipped galvanized or Type 304 stainless steel or better hangers, support, and hardware.

C. Plumbing Piping - Water:
1. Conform to MSS SP 69.
2. Hangers for Pipe Sizes ½- to 1-½-inch: Malleable iron or Carbon steel, adjustable, clevis.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Vertical Support: Steel riser clamp.
7. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
8. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, Carbon-steel ring.
10. For Exterior and Humid Areas: Furnished hot-dipped galvanized or Type 304 stainless steel or better hangers, support, and hardware.

2.2 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. See Division 07.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire-rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire-rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sealant: Acrylic.

2.6 MECHANICAL SLEEVE SEALS

A. Manufacturers:
   1. Thunderline Link-Seal, Inc.
   2. NMP Corporation.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber-sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

3.2 PREPARATION

A. Obtain permission from Architect/Engineer before using powder-actuated anchors.

B. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below, and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with MSS SP 69.

B. Support horizontal piping as scheduled. Coordinate with Structural Drawings.

C. Support vertical piping as scheduled.

D. Install hangers with minimum ½-inch space between finished covering and adjacent work.

E. Place hangers within 12 inches of each horizontal elbow.

F. Use hangers with 1-½-inch minimum vertical adjustment.

G. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

I. Support riser piping independently of connected horizontal piping.

J. Provide copper plated hangers and supports for copper piping.

K. Design hangers for pipe movement without disengagement of supported pipe.

L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

N. Provide vibration isolators type hangers or supports for pipes after vibration-isolated equipment is installed. Refer to Section 23 05 48.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Refer to Section 23 05 29 for installation requirements.

3.6 INSTALLATION - FLASHING

A. Refer to Division 07.

3.7 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

3.8 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.9 SCHEDULES

HANGERS AND SUPPORTS (TABLE 313.1)MATERIALS	TYPES OF JOINTS	HORIZONTAL	VERTICAL
CAST	LEAD AND OAKUM	5 FEET, EXCEPT 10 FEET WHERE 10 FOOT LENGTHS ARE INSTALLED (NOTES 1,2,3)	BASE AND EACH FLOOR, NOT TO EXCEED 15 FEET
CAST	COMPRESSION GASKET	EVERY OTHER JOINT, UNLESS OVER 4 FEET THEN SUPPORT EACH JOINT (NOTES 1,2,3)	BASE AND EACH FLOOR, NOT TO EXCEED 15 FEET
CAST-IRON HUBLESS	SHEILDED COUPLING	EVERY OTHER JOINT, UNLESS OVER 4 FEET THEN SUPPORT EACH JOINT (NOTES 1,2,3,4)	BASE AND EACH FLOOR, NOT TO EXCEED 15 FEET
COPPER TUBE AND PIPE	SOLDERED OR BRAZED	1-1/2 INCHES AND SMALLER, 6 FEET; 2 INCHES AND LARGER, 10 FEET	EACH FLOOR, NOT TO EXCEED 10 FEET (NOTE 5)

STEEL AND BRASS PIPE FOR WATER OR DWV	THREADED OR WELDED	3/4 INCH AND SMALLER, 10 FEET; 1 INCH AND LARGER, 12 FEET	EVERY OTHER FLOOR, NOT TO EXCEED 25 FEET (NOTE 5)
STEEL, BRASS, AND TINNED COPPER PIPE FOR GAS	THREADED OR WELDED	1/2 INCH, 6 FEET; 3/4 INCH AND 1 INCH, 8 FEET; 1-1/4 INCHES AND LARGER, 10 FEET	1/2 INCH, 6 FEET; 3/4 INCH AND 1 INCH, 8 FEET; 1-1/4 INCHES EVERY FLOOR LEVEL
SCHEDULE 40 PVC AND ABS DWV	SOLVENT CEMENTED	ALL SIZES, 4 FEET; ALLOW FOR EXPANSION EVERY 30 FEET (NOTES 3,6)	BASE AND EACH FLOOR; PROVIDE MID-STORY GUIDES; PROVIDE FOR EXPANSION EVERY 30 FEET (NOTE 6)
CPVC	SOLVENT CEMENTED	1 INCH AND SMALLER, 3 FEET; 1-1/4 INCHES AND LARGER, 4 FEET	BASE AND EACH FLOOR; PROVIDE MID-STORY GUIDES (NOTE 6)
LEAD	WIPED OR BURNED	CONTINUOUS SUPPORT	NOT TO EXCEED 4 FEET
COPPER	MECHANICAL	IN ACCORDANCE WITH STANDARDS ACCEPTABLE TO THE AUTHORITY HAVING JURISDICTION	IN ACCORDANCE WITH STANDARDS ACCEPTABLE TO THE AUTHORITY HAVING JURISDICTION
STEEL AND BRASS	MECHANICAL	IN ACCORDANCE WITH STANDARDS ACCEPTABLE TO THE AUTHORITY HAVING JURISDICTION	IN ACCORDANCE WITH STANDARDS ACCEPTABLE TO THE AUTHORITY HAVING JURISDICTION

NOTES:

1. SUPPORT ADJACENT TO JOINT, NOT TO EXCEED 18 INCHES.
2. BRACE NOT TO EXCEED 40 FOOT INTERVALS TO PREVENT HORIZONTAL MOVEMENT.
3. SUPPORT AT EACH HORIZONTAL BRANCH CONNECTION.
4. HANGERS SHALL NOT BE PLACED ON THE COUPLING.
5. VERTICAL WATER LINES SHALL BE PERMITTED TO BE SUPPORTED IN ACCORDANCE WITH RECOGNIZED ENGINEERING PRINCIPLES WITH REGARD TO EXPANSION AND CONTRACTION, WHERE FIREST APPROVED BY THE AUTHORITY HAVING JURISDICTION.
6. SEE THE APPROPRIATE IAPMO INSTALLATION STANDARD FOR EXPANSION AND OTHER SPECIAL REQUIREMENTS.

HANGER AND ROD SIZES (TABLE 313.6)

PIPE AND TUBE SIZE	ROD SIZE
(INCHES)	(INCHES)
1/2 - 4	3/8
5 - 8	1/2

END OF SECTION

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Nameplates.
2. Tags.
3. Pipe markers.
4. Ceiling tacks.
5. Labels.

B. Related Sections:
1. NONE.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. NONE.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

C. Verify painting is complete where applicable per Section 09 97 20 prior to installation of identification for piping and equipment.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:
1. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches square.

B. Metal Tags:
   1. Brass, Aluminum, or Stainless Steel with stamped letters; tag size minimum 1-½-inches square with finished edges.

C. Information Tags:
   1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-¼ x 5-5/8 inches with grommet and self-locking nylon ties.

D. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum or plastic laminated frame.

2.3 PLASTIC MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Markers:
   1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Markers:
   1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Plastic Underground Markers:
   1. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.4 CEILING TACKS

A. Description: Steel or plastic with ¾-inch diameter color-coded head.

B. Color code as approved by Owner. If no preference by Owner, color as follows:
   1. Plumbing valves: Green.
   2. Refer to Section 23 05 53 for other equipment.

2.5 LABELS

A. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

PART 3 -- EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags using corrosion resistant chain. Number tags consecutively by location.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify piping, concealed or exposed, with plastic markers, or plastic tape markers.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification:
      a. Not to exceed 20 feet on straight runs including risers and drops.
      b. Adjacent to each valve and tee.
      c. At each side of penetration of structure or enclosure.
      d. At each obstruction.

J. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 PAINTING

A. Prepare and coordinate insulated piping for painting. Refer to Section 09 97 20 for colors and coatings.

END OF SECTION

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SECTION 22 07 00 - PLUMBING INSULATION

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Piping system insulation.
2. Equipment insulation.
3. Pipe insulation jackets.
4. Equipment insulation jackets.
5. Insulation accessories including vapor retarders and accessories.

B. Related Sections:
1. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product and Execution requirements for inserts at hanger locations.
2. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for plumbing piping and equipment identification.
3. Section 23 07 00 – HVAC Insulation: Pipe insulation thickness requirements.

1.2 REFERENCES

A. ASTM International:
1. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
2. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
3. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

A. NONE.

1.4 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature during and after installation for minimum period as recommended by manufacturer.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 PIPE: MAN MADE MINERAL FIBER

A. Insulation: ASTM C547 Mineral Fiber Pipe Insulation, Type I, 850 °F
   1. Insulation Conductivity Rating: Maximum: 0.28 Btu-in/(h-ft2-°F) at 100-°F mean rating temperature.

B. Applications on Austenitic stainless steel: Conform to ASTM C795.

C. Vapor Retarder Jacket:
   1. White Kraft paper with glass fiber yarn, bonded to aluminized film.
   2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

D. Vapor Retarder Lap Adhesive:
   1. Compatible with insulation.

2.2 PIPE INSULATION AND EQUIPMENT JACKETS

A. PVC Plastic Pipe Jacket:
   1. Product Description: One-piece molded type fitting covers and sheet material, off-white color.
   2. Thickness: 10 mil.
   3. Connections: Brush on welding adhesive.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify piping and equipment has been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION – PIPING

A. Exposed Piping: Locate insulation and cover seams in least visible locations.

B. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

C. Manmade mineral fiber insulated pipes conveying fluids below ambient temperature:
   1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. For hot piping conveying fluids over 140 °F, insulate flanges and unions at equipment.

E. Manmade mineral fiber insulated pipes conveying fluids above ambient temperature:
   1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

F. Inserts and Shields:
   1. Application: Piping or Equipment 2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under finish jacket.
4. Insert configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be site fabricated or factory fabricated.
5. Insert material: Compression resistant insulating material suitable for planned temperature range and service.

G. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.

H. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

3.3 INSTALLATION - EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

D. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

E. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

F. For hot equipment containing fluids over 140 °F, insulate flanges and unions with removable sections and jackets.

G. Mineral fiber insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor retarder, factory-applied or field-applied. Finish with glass cloth and adhesive.

H. Finish insulation at supports, protrusions, and interruptions.

I. Nameplates and ASME Stamps: Bevel and seal insulation around. Do not insulate over.

J. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.4 SCHEDULES

A. Plumbing Systems:
1. Domestic Hot Water Systems:
a. Material: Man Made Mineral Fiber Insulation
b. Thickness:
1) Pipe diameter less than 1-½-inches: 1 inch.
2) Pipe diameter 1-½-inches and greater: 1-½-inches.
2. Domestic Cold-Water Systems:
a. Material: Man Made Mineral Fiber Insulation
b. Thickness: 1 inch.
3. Plumbing Vents Within 10 feet of Exterior:
a. Material: Man Made Mineral Fiber Insulation
b. Thickness: 1 inch.

END OF SECTION

SECTION 22 11 00 - FACILITY WATER DISTRIBUTION

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Domestic water piping, buried within 5 feet of building.
2. Domestic water piping, above grade.
3. Unions and flanges.
4. Valves.
5. Pipe hangers and supports.
6. Thermometers.
7. Flow control/balancing valves.
8. Relief valves.
9. Hydrants.
10. Backflow preventers.
11. Water hammer arrestors.
12. Thermostatic mixing valves.
13. Diaphragm-type compression tanks.
14. In-line circulator pumps.

B. Related Sections:
1. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports for placement by this section.
2. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification and valve tags for placement by this section.
3. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.
4. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping: Execution requirements for pipe expansion devices for placement by this section.
5. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI Z21.22 - Relief Valves for Hot Water Supply Systems.

B. American Society of Mechanical Engineers:
1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B31.9 - Building Services Piping.
4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
5. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. American Society of Sanitary Engineering:
1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
2. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
3. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
4. ASSE 1052 – Performance Requirements for Hose Connection Backflow Preventers.
5. ASSE 1061 – Performance Requirements for Removable and Non-Removable Push-Fit Fittings.

D. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
5. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
6. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
7. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
8. ASTM E1 - Standard Specification for ASTM Thermometers.
9. ASTM F441/F441M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
10. ASTM F442/F442M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
11. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

E. American Water Works Association:
1. AWWA C651 - Disinfecting Water Mains.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 67 - Butterfly Valves.
2. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
3. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
4. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

G. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

H. NSF International:
1. NSF 14 – Plastics Piping System Components and Related Materials.
2. NSF 61 – Drinking Water System Components – Health Effects.
3. NSF 372 – Drinking Water Components – Lead Content.

I. Plumbing and Drainage Institute:
1. PDI WH201 - Water Hammer Arrester Standard.

J. U. S. Department of Housing and Urban Development:
1. FHA Bulletin 76 – Use of Materials Bulletin No. 76: Chlorinated Poly (Vinyl Chloride) CPVC and Polybutylene (PB) Hot and Cold-Water Distribution Piping.

1.3 SYSTEM DESCRIPTION

A. The Plumbing Contractor is responsible for items in this Section.

B. Plumbing Contractor shall provide and install all water meters. Coordinate meter requirements with the City.

C. Water distribution system to be either copper.

D. Pipe sizes indicated on drawings are based on ASTM B88 Type L copper tubing. For non-metallic pipe, contractor to verify nominal pipe size for equivalent pressure drop, flow rate, and velocity.

1.4 SUBMITTALS

A. Product Data:
   1. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
   2. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and equipment.

B. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

C. Pressure Test Report: Submit verification of pressure test report. Include test type, testing pressure, and length of time.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. CPVC [Minnesota 2012]: Chlorinated polyvinyl chloride (CPVC) pipe together with recommended fittings must by tested by the manufacturer at 150 psi and 210 °F for a period of not less than 48 hours by a qualified independent testing laboratory acceptable to the administrative authority.

C. Lead-free: All fittings, valves, fixtures, and accessories that contact potable water shall be lead-free compliant per NSF 61 and NSF 372.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material.
   1. Fittings: ASTM D2466, Schedule 40, PVC.

2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
3. The installation must comply with ASTM D2774.
4. No more than 2 feet may be exposed within the building.

B. PVC Pipe: AWWA C900 Class 150, polyvinyl chloride (PVC) material, NSF 14, NSF 64.
1. Fittings: AWWA C110, standard thickness.
2. Joints: ASTM D3139 compression gasket ring.
3. The installation must comply with AWWA 605.
4. No more than 2 feet may be exposed within the building.

2.2 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tubing (2-inch diameter and smaller): ASTM B88, Type L, hard drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 °F.
3. Joints: Push-fit complying with NSF 61 and ASSE 1061. Crimping tool approved by Manufacturer and local Authority Having Jurisdiction. For pipe sizes 3/8 to 2 inches only.

B. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M, NSF 14, FHA Bulletin 76, chlorinated polyvinyl chloride (CPVC) material.
1. Pipe Sizes 2-½-Inches to 6 Inches: Schedule 80.
2. Fittings: ASTM D2846/D2846Mor ASTM F441/F441M, CPVC.
3. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
4. Smoke and Fire Ratings: Where plenum-rated piping is required, pipe shall be either pre-insulated or field insulated. Comply with ASTM E84.
a. Flame Spread Classification: Less than 25.
b. Smoke Development Rating: Less than 50.

2.3 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
1. Copper Piping: Class 150, bronze unions with soldered.
2. Dielectric Connections: Dielectric union connections are NOT permitted.
3. CPVC Piping: CPVC.

B. Flanges for Pipe 2-½-inches and Larger:
1. PVC Piping: PVC flanges.
2. CPVC Piping: CPVC flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

C. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.4 DIELECTRIC FITTINGS

A. Dielectric Waterway Connectors:
1. Manufacturers:
a. ClearFlow (Elstel Perfection)
2. Dissimilar metals shall be separated with a dielectric waterway connector
3. Material: Electro-zinc-plated steel casing, insert plastic lining, threaded ends.

2.5 BALL VALVES

A. Manufacturers:
1. Crane Valve, North America.
2. Hammond Valve.
3. Milwaukee Valve Company.
4. NIBCO, Inc.

5. Stockham Valves & Fittings.

B. 2 inches and Smaller: MSS SP 110, one-piece bronze body, chrome plated brass ball, regular port, Teflon seats, blowout proof stem, solder or threaded ends with lever handle.

2.6 BUTTERFLY VALVES

A. Manufacturers:
1. Crane Valve, North America.
2. Hammond Valve.
3. Milwaukee Valve Company.
4. NIBCO, Inc.
5. Stockham Valves & Fittings.
6. Victaulic Co.

B. 2-½-inches and Larger: MSS SP 67, Class 150.
1. Body: Cast or ductile iron, wafer lug or grooved ends, stainless steel stem, extended neck.
2. Disc: Nickel-plated ductile iron.
3. Seat: Resilient replaceable EPDM.
4. Handle and Operator: 10 position lever handle.

C. CPVC: 2 inches through 10 inches: 150 psi at 73 °F water temperature, maximum service temperature 210 °F, one- or two-piece body, ASTM D1784 CPVC, lug type flange facing, disc encapsulated with EPDM, stainless steel shaft, locking lever handle.

2.7 CHECK VALVES

A. Horizontal Swing Check Valves:
1. Manufacturers:
a. Crane Valve, North America.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO, Inc.
e. Stockham Valves & Fittings.
2. 2 inches and Smaller: MSS SP 80, bronze body and cap, bronze seat, Buna-N disc, solder or threaded ends.
3. 2-½-inches and Larger: MSS SP 71, cast iron body, bolted cap, bronze or cast iron disc, flanged ends.

2.8 PIPE HANGERS AND SUPPORTS

A. Refer to Section 22 05 29.

2.9 STEM TYPE THERMOMETERS

A. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: Brass, ¾-inch NPT, Length as required for proper fluid sensing.
4. Accuracy: 2 percent.
5. Calibration: Both °F and °C.
6. Range:
a. Hot Water: 30 °F to 160 °F.
b. Cold Water: 0 °F to 100 °F.

2.10 FLOW CONTROL/BALANCING VALVES

A. Manufacturers:

1. Bell & Gossett (Xylem, Inc).
2. Danfoss.
3. Griswold Controls.
4. Taco, Inc.
5. Victaulic Co.
6. ThermOmegaTech.

B. Type: Flow control valve shall be manual balancing valve

C. Construction: Brass, bronze, or stainless-steel body with union and isolation ball valve on inlet and outlet, and temperature and pressure test plugs.

D. Calibration: When fully closed the TRV shall bypass a minimum of 0.1 GPM to maintain dynamic control of the hot water recirculation loop. Fully open TRV shall modulate towards a minimum closed position upon sensing a water temperature 3 °F or more above setpoint.

E. Accessories: Valve shall include internal/integrated check valve.

2.11 RELIEF VALVES

A. Pressure Relief:
1. ANSI Z21.22 certified, bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure Relief:
1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 °F, capacity ASME certified and labeled.

2.12 HOSE BIBBS

A. Manufacturers:
1. Woodford Manufacturing Company.
2. Zurn Wilkins (Zurn Industries, LLC).
3. Leonard Valve Company.

B. (HB-1) Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with hand wheel.
1. Backflow Preventers: Integral vacuum breaker in conformance with ASSE 1011.

2.13 HYDRANTS

A. Manufacturers:
1. Woodford Manufacturing Company.
2. Zurn Wilkins (Zurn Industries, LLC).
3. Leonard Valve Company.

B. (H-1) Wall Hydrant: Automatic draining with anti-siphon vacuum breaker (ASSE 1011). ASSE Standard 1019-B approved. ¾" inlet and outlet. Hardened stainless steel operating stem and one-piece valve plunger to control both flow and drain functions. Exterior finish to be chrome plated. Loose tee key to be furnished with each hydrant.

C. (YH-1) Yard Hydrant: Non-freeze, non-draining sanitary yard hydrant conforming to ASSE 1057, 1 inch inlet, bury depth to place the valve below frost, lockable, with integral backflow protection. Basis of design: Woodford S3 series or equal.

2.14 BACKFLOW PREVENTERS

A. Manufacturers:
1. Apollo Valves (Aalberts Industries N.V.)
2. Watts Water Technologies, Inc.

3. Zurn Wilkins (Zurn Industries, LLC).

B. Reduced Pressure Backflow Preventers:
   1. Comply with ASSE 1013.
   2. Bronze body, with bronze internal parts and stainless-steel springs.
   3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

C. Double Check Valve Assemblies: Comply with ASSE 1012; Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.

2.15 WATER HAMMER ARRESTORS

A. ASSE 1010; copper construction, piston type sized in accordance with PDI WH-201.

B. Pre-charged suitable for operation in temperature range 34 to 250 °F and maximum 150 psi working pressure.

2.16 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers:
   1. Watts Water Technologies, Inc.
   2. AMTROL, Inc.
   3. Bell & Gossett (Xylem).

B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible diaphragm sealed into tank, and steel legs or saddles.

2.17 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:
   1. Bell & Gosset (Xylem)
   2. Grundfos Pumps Corp.
   3. Taco, Inc.
   4. Armstrong Fluid Technology.

B. Description: UL-listed and CSA approved, all bronze, suitable for 140˚F hot water system. Each pump shall be piped with circuit setter valve at the pump discharge, Teflon sealed ball valve at the suction side. Both valves shall be full sized as indicated on the drawings. All plumps to be flange-mounted for maintenance.

C. Performance: Refer to Drawings.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - METERS

A. Install Work in accordance with Municipality regulations and standards.

3.4 INSTALLATION - THERMOMETERS AND GAGES

A. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-½-inches for installation of thermometer sockets. Allow clearance from insulation.

B. Provide instruments with scale ranges selected according to service with largest appropriate scale.

C. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

D. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.5 INSTALLATION - HANGERS AND SUPPORTS

A. Refer to Section 22 05 29

3.6 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.

B. Establish elevations of buried piping with not less than 4 ft of cover.

C. Establish minimum separation from other services and sanitary sewer piping in accordance with applicable code.

D. Remove scale and dirt on inside of piping before assembly.

E. Excavate pipe trench in accordance with Division 31.

F. Install pipe on prepared bedding.

G. Route pipe in straight line.

H. Install pipe to allow for expansion and contraction without stressing pipe or joints.

I. Non-Metallic Pipe: Install trace wire continuously over top of pipe; coordinate with Division 31.

J. Sleeve pipes passing through partitions, walls, floors, and foundations.

K. Pipe Cover and Backfilling:
   1. Backfill trench in accordance with Division 31.

3.7 INSTALLATION - ABOVE GROUND PIPING

A. CPVC piping to be used in corrosive environments and where indicated on drawings. For non-metallic pipe, verify nominal pipe size of equivalent pressure drop, flow rate, and velocity.

B. Install non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

E. Group piping whenever practical at common elevations.

F. Slope piping and arrange systems to drain at low points.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.

I. Provide access where valves and fittings are not accessible.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 09.

M. Install domestic water piping in accordance with ASME B31.9.

N. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
   1. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
   2. For large holes in wall, floor, and ceiling assemblies: Infill, patch, and seal the annular space around pipe penetration. Match materials and finishes of adjacent work.

O. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Division 07.

P. Install unions downstream of valves and at equipment or apparatus connections.

Q. Install valves with stems upright or horizontal, not inverted.

R. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

S. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

T. Install butterfly valves for throttling, bypass, or manual flow control services.

U. Provide check valves on discharge of water pumps.

V. Provide flow controls in water circulating systems as indicated on Drawings.

W. Install potable water protection devices on plumbing lines where contamination of domestic water may occur: on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

X. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

Y. Install water hammer arrestors complete with isolation valve.
   1. Water hammer arrestor and isolation valve shall be installed in accessible locations.
      a. Walls and hard ceilings are not considered accessible locations.
   2. Refer to Drawings for water hammer arrestor locations.

Z. Water supply connections to fixtures or equipment which have inlets below the spill line, must be provided with an approved backflow preventer.

AA. Valves shall be installed permitting the water supply to each individual fixture to be shut off without disrupting any other portion of the building. An accessible control valve shall be installed ahead of each slip joint connection at a plumbing fixture.

BB. Lead-free: all fittings, valves, and fixtures and accessories that contact potable water shall be lead-free compliant per NSF 61 and NSF 372.

CC. Where two separate handles control the hot and cold water, the left-handed control of the faucet where facing the fixture fitting outlet shall control the hot water. Faucets and diverter shall be connected to the water distribution system so that hot water corresponds to the left side of the fittings.

DD. The installation of reduced pressure zone assemblies, double check valve assemblies, pressure vacuum breakers, spill-proof vacuum breakers, reduced pressure detector fire protection assemblies, or double check detector fire protection assemblies is permitted only when a testing and inspection

program acceptable to the administrative authority is provided (see Minnesota rules, chapter 4714, section 603.5.23). The administrative authority and water purveyor must be notified prior to installation. Devices must be tested upon initial installation and not less than annually, and records must be kept. Installations must be at least 12-inches and not more than 5-feet above finished floor or ground level unless a permanent platform for access is provided.

EE. Wall hydrants must meet ASSE Standard 1019. Where permitted by the administrative authority, wall hydrants may utilize non-removable ASSE 1052 backflow preventers or non-removable ASSE 1011 vacuum breakers and provision is made to protect from freezing (see Minnesota Rules, Chapter 4714, Sections 603.5.7, 312.6, and 301.1.2).

FF. Water heaters must be accessible with sufficient clearance for maintenance and repair. Unlisted water heaters must have 12-inches minimum clearance on all sides (see Minnesota Rules, Chapter 4714, Sections 507.26 and 504.3.2).

3.8 INSTALLATION – CPVC SYSTEMS

A. CPVC [Minnesota 2012]: Installation must be in accordance with IAPMO 20-98; however, this material may be air tested.

B. Install U-bend type pipe expansion loops every 50 feet. Minimum U-bend dimensions shall be 22 inches by 11 inches by 22 inches. Install guides per CPVC system manufacturer's installation requirements.

3.9 INSTALLATION - PUMPS

A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.

C. Install pumps on vibration isolators. Refer to Section 23 05 48.

D. Install flexible connectors at or near pumps where piping configuration does not absorb vibration. Refer to Section 23 21 16.

E. Provide line sized shut-off valve and pump suction fitting on pump suction, and line sized soft seat check valve, balancing valve, and shut-off valve on pump discharge. Refer to Section 23 21 16.

F. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.

G. Provide air cock and drain connection on horizontal pump casings.

H. Provide drains for bases and seals.

I. Check, align, and certify alignment of base mounted pumps prior to start-up.

J. Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to .

K. Lubricate pumps before start-up.

3.10 INSTALLATION - SERVICE CONNECTIONS

A. Provide new water service complete with approved reduced pressure back-flow preventer and water meter with by-pass valves. Provide deduct meter if required by Municipality. Water service shall be

installed to within 5 feet of building exterior by Utility Contractor. Plumbing Contractor shall install water service from within 5 feet of building exterior to inside the building.

3.11 FIELD QUALITY CONTROL

A. Test domestic water piping system in accordance with local Authority Having Jurisdiction.

3.12 CLEANING

A. Prior to starting work, verify system is complete, flushed, and clean.

B. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.

D. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. When final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION

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SECTION 22 13 00 - FACILITY SANITARY SEWERAGE

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Sanitary sewer piping below grade.
2. Sanitary sewer piping above grade.
3. Pipe hangers and supports.
4. Floor drains.
5. Cleanouts.

B. Related Sections:
1. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports for placement by this section.
2. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
3. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.
4. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping: Execution requirements for pipe expansion devices for placement by this section.
5. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME A112.6.3 - Floor Drains and Trench Drains.
2. ASME A112.14.1 - Backwater Valves.
3. ASME A112.36.2M - Cleanouts.

B. ASTM International:
1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
3. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
4. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
5. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
6. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

C. Cast Iron Soil Pipe Institute:
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

1.3 SUBMITTALS

A. Product Data:
1. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

2. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of equipment and clean-outs.

1.5 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 SANITARY SEWER PIPING, BELOW GRADE

A. Plastic Pipe: ASTM D2665, polyvinyl chloride (PVC) material.
1. Fittings: PVC, ASTM D2665.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, ASTM A888, hub-less, service weight.
1. Fittings: Cast iron, CISPI 301.
2. Joints: CISPI 310, neoprene gaskets and stainless-steel clamp-and-shield assemblies.

B. PVC Pipe: ASTM D2665, polyvinyl chloride (PVC) material.
1. Fittings: ASTM D2665, PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.3 PIPE HANGERS AND SUPPORTS

A. Refer to Section 22 05 29.

2.4 FLOOR DRAINS

A. Manufacturers:
1. Jay R. Smith Manufacturing Co.
2. Josam Co.
3. MIFAB, Inc.
4. Sioux Chief Manufacturing Co.
5. Watts Water Technologies Co.

6. Zurn Industries, LLC.

A. Floor Drain (FD-1): ASME A112.21.1; round strainer, cast iron floor drain with nickel bronze grate (adjustable).

B. Floor Drain (FD-2): ASME A112.21.1; chemical- and corrosion-resistant, type 316 stainless steel material.

C. Trench Drains (TD-1): Basis-of-Design Zurn Z886.

1. For non-standard installations, the Plumbing Contractor shall coordinate the layout and the required product modifications and interconnections with manufacturer and/or manufacturer's representative.

2.5 CLEANOUTS

1. Jay R. Smith Manufacturing Co.
2. Josam Co.
3. MIFAB, Inc.
4. Sioux Chief Manufacturing Co.
5. Watts Water Technologies Co.
6. Zurn Industries, LLC.

B. Interior Finished Floor Areas: Epoxy coated cast iron floor cleanout with 5-inch round adjustable gasketed nickel bronze top, stainless steel carpet marker, removable gas tight gasketed brass cleanout plug, and no hub outlet.

C. Interior Finished Wall Areas: Epoxy coated cast iron floor cleanout with 5-inch round adjustable gasketed heavy-duty stainless-steel top, removable gas tight gasketed brass plug, and no hub outlet.

D. Interior Finished Floor Areas: epoxy coated cast iron floor cleanout with 5-inch x 5-inch square adjustable gasketed heavy-duty stainless-steel top, removable gas tight gasketed brass plug, and no hub outlet.

E. Interior Finished Wall Areas: wall cleanout with two-piece expandable cleanout plug, stainless steel access cover, and vandal proof stainless steel screw.

F. Interior Unfinished Accessible Areas: Cast iron stack cleanout with threaded brass raised head cleanout plug, and no hub connections.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Refer to Section 22 05 29.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify existing piping system connection size, location, and invert is as indicated on Drawings.

B. Establish invert elevations, sloped for drainage to ¼-inch per foot minimum of buried piping with not less than 2 ft of cover. Maintain gradients.

C. Establish minimum separation of drainage piping from other services piping in accordance with local code.

D. Remove scale and dirt on inside of piping before assembly.

E. Excavate pipe trench in accordance with Division 31.

F. Install pipe to elevation required to maintain slope.

G. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth.

H. Install pipe on prepared bedding.

I. Route pipe in straight line.

J. Install trace wire continuous buried 6 inches below finish grade, above pipeline; coordinate with Division 31.

K. All horizontal branch drains shall be uniformly pitched at ¼-inch per foot.

L. The building sewer must be installed with a uniform slope of at least ¼-inch per foot. Where municipal sewer depth, structural features, or building arrangement preclude this slope, a slope of 1/8-inch per foot minimum may be utilized if approved by the authority having jurisdiction.

M. All sinks, except for lavatories and private-use bar sinks, must be provided with 2-inch minimum vertical fixture drains. Laundry tubs, domestic clothes washers, and urinals also require 2-inch minimum vertical drains.

N. Pipe Cover and Backfilling:
   1. Backfill trench in accordance with Division 31.
   2. Maintain optimum moisture content of fill material to attain required compaction density.
   3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 6 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
   4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
   5. Do not use wheeled or tracked vehicles for tamping.

3.5 INSTALLATION - ABOVE GROUND PIPING

A. Establish invert elevations, slopes for drainage to ¼-inch per foot minimum. Maintain gradients.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.

C. Install floor cleanouts at elevation to accommodate finished floor.

D. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

F. Install piping to maintain headroom. Do not spread piping, conserve space.

G. Group piping whenever practical at common elevations.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

J. Provide access where valves and fittings are not accessible.

K. Install piping penetrating roofed areas to maintain integrity of roof assembly.

L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 09.

N. Install bell and spigot pipe with bell end upstream.

O. Sleeve pipes passing through partitions, walls, and floors.
   1. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
   2. For large holes in wall, floor, and ceiling assemblies: Infill, patch, and seal the annular space around pipe penetration. Match materials and finishes of adjacent work.

P. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Division 07.

Q. Support cast iron drainage piping at every joint.

R. Installation standards for ABS and PVC allow the use of offsets, expansion joints, or restraints provided conditions of proper support and movement are met. Accordingly, aboveground horizontal and vertical plastic piping must be installed with restraint fittings or a minimum 24-inch, 45-degree offset every 30 feet.

3.6 FIELD QUALITY CONTROL

A. Cast iron soil pipe and fittings must be marked with their country of origin, the collective trademark of the Cast Iron Soil Pipe Institute, and identification of the original manufacturer in addition to markings required by reference standards (See Minnesota Rules, Chapter 4714, Section 701.0). They shall also be listed by NSF International.

B. Test sanitary waste and vent piping system in accordance with local Authority Having Jurisdiction.

END OF SECTION

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SECTION 22 34 00 - FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Commercial gas-fired water heaters.
2. PVC venting.

B. Related Sections:
1. Section 22 07 00 - Plumbing Insulation: Field applied insulation for domestic water heaters.
2. Section: 22 11 00 - Facility Water Distribution: Supply connections to domestic water heaters.
3. Section 23 11 23 - Facility Natural-Gas Piping: Execution requirements for gas piping connections specified by this section.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI Z21.10.3 - Gas Water Heaters - Vol. III Storage, with Input Ratings Above 75,000 Btu/hr, Circulating and Instantaneous Water Heaters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:
1. ASME PTC 25 - Pressure Relief Devices.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. National Fire Protection Association:
1. NFPA 54 - National Fuel Gas Code.

E. NSF International:
1. NSF 61 – Drinking Water System Components – Health Effects.
2. NSF 372 – Drinking Water Components – Lead Content.

F. United States Department of Energy:
1. DOE 10 CFR - Uniform Test Method for Measuring the Energy Consumption of Furnaces.

1.3 SYSTEM DESCRIPTION

A. The Plumbing Contractor is responsible for items in this Section.

1.4 SUBMITTALS

A. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.

B. Product Data:
1. Water Heaters: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit electrical characteristics and connection locations.
2. Vent Piping.

C. Manufacturer's Installation Instructions: Submit mounting and support requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Conform to ASME Section VIII for construction of water heaters. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

C. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1 when tested in accordance with DOE 10 CFR.

D. Lead-free: All fittings, valves, fixtures, and accessories that contact potable water shall be lead-free compliant per NSF 61 and NSF 372.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept water heaters on site in original labeled cartons. Inspect for damage.

B. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Furnish three-year manufacturer warranty for domestic water heaters packaged water heating systems.

PART 2 -- PRODUCTS

2.1 COMMERCIAL GAS FIRED WATER HEATERS

A. Manufacturers:
1. A. O. Smith Corp.
2. Bradford White Corp.
3. Lochinvar, LLC.
4. State Industries.
5. Bock.
6. PVI.

B. Type: Automatic, natural gas-fired, vertical storage.

C. Performance:
1. Refer to Drawings.

D. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4-inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber or polyurethane, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.

E. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

F. Controls: Shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout for remote monitoring, leak detection and fault alert.

G. Water heater to have internal heat traps.
   1. Contractor Option: Provide external heat traps.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with Division 26 and as indicated on Drawings.

B. Disconnect Switch: Factory mount disconnect switch.

2.3 INTAKE AND EXHAUST VENT PIPING

A. Plastic Pipe: ASTM D2665, polyvinyl chloride (PVC).
   1. Fittings: ASTM D2665, PVC.
   2. Joints: ASTM D2855, solvent veld with ASTM D2564 solvent cement.

B. Terminals: Refer to Drawings.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Maintain manufacturer's recommended clearances around and over water heaters.

B. Install water heater on concrete housekeeping pad, minimum 4 inches high and 6 inches larger than water heater base on each side. Refer to Section Division 03.

C. Connect natural gas piping in accordance with NFPA 54.

D. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.

E. Connect domestic water piping to supply and return water heater connections.

F. Install the following piping accessories. Refer to Section 22 11 00.
   1. On supply:
      a. Thermometer well and thermometer.
      b. Pressure gage.
      c. Shutoff valve.
   2. On return:
      a. Thermometer well and thermometer.
      b. Shutoff valve.

G. Install piping accessories on natural gas piping connections. Refer to Section 23 11 23.

H. Install discharge piping from relief valves, drain valves, and condensate discharge to nearest floor drain.

I. Install diaphragm expansion tank on water heater.

J. Install water heater trim and accessories furnished loose for field mounting.

K. Install electrical devices furnished loose for field mounting.

L. Install control wiring between water heater control panel and field mounted control devices.

M. Connect vent piping per manufacturer’s instructions. Refer to Section 23 51 00.

N. Locate vent-piping terminations per local code and manufacturer’s written instructions.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Emergency Fixtures.

B. Related Sections:
1. Section 22 11 00 - Facility Water Distribution: Supply connections to plumbing fixtures.
2. Section 22 13 00 - Facility Sanitary Sewerage: Waste connections to plumbing fixtures.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ANSI Z124.1 - Plastic Bathtub Units.
3. ANSI Z124.2 - Plastic Shower Units.
4. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.

B. Air-Conditioning and Refrigeration Institute:
1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.

C. American Society of Mechanical Engineers:
1. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2. ASME A112.18.1 - Plumbing Supply Fittings.
3. ASME A112.19.1 - Enameled Cast Iron and Enameled Steel Plumbing Fixtures.
4. ASME A112.19.2 - Ceramic Plumbing Fixtures.
5. ASME A112.19.3 - Stainless Steel Plumbing Fixtures.
6. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
7. ASME A112.19.5 – Flush Valves and Spuds for Water Closets, Urinals, and Tanks.

D. NSF International:
1. NSF 61 – Drinking Water System Components – Health Effects.
2. NSF 372 – Drinking Water Components – Lead Content.

1.3 SUBMITTALS

A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit fixture, trim, exploded view, and replacement parts lists.

1.5 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Provide products requiring electrical connections listed and classified by testing firm acceptable to Authority Having Jurisdiction as suitable for purpose specified and indicated.

C. Lead-free: All fittings, valves, fixtures, and accessories that contact potable water shall be lead-free compliant per NSF 61 and NSF 372.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 -- PRODUCTS

2.1 SAFETY FIXTURES

A. (EEWS-1) Combination Shower and Eye and Face Wash:
   1. Manufacturers:
      a. Acorn Safety (Morris Group International).
      b. Bradley Corp.
      c. Encon Safety Products.
      d. Haws.
      e. Speakman.
   2. Compliance:
      a. ADA Compliant.
      b. ANSI Z358.1.
         1) Accessories:
            a) 180-oz. saline concentrate (#32-002050)
            b) Water preservative/additive
            c) Wall mounting bracket
            d) Inspection tag
            e) Sign & instruction booklet

B. (S-2) Sink, Double Bowl.
   1. Sink:
      a. Manufacturers:
         1) American Standard Brands.
         2) Elkay Manufacturing Co.
         3) Kohler Co.
         4) Mansfield Plumbing.
         5) PROFLO.
      b. Mount: Top mount.
      c. Compliance:
         1) ASME A112.19.3.
         2) ADA compliant.
   2. Faucet:
      a. Manufacturers:
         1) Chicago Faucets.
         2) Delta Faucet Co.
         3) Elkay Manufacturing Co. (Dayton).
         4) Moen, Inc.
      b. Compliance:
         1) ASME A112.18.1.
         2) Low-lead compliant.

3) ADA compliant.

3. Accessories:
   a. Wheel handle angle stops.
   b. Rigid supplies.
   c. Trap and waste insulated and offset to meet ADA compliance.
      1) Manufacturers:
         a) Truebro (IPS Corp.).
         b) Plumberex Specialty Products Co.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify electric power is available and of correct characteristics.

C. Confirm millwork is constructed with adequate provision for installation of counter-top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install Work in accordance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Install each fixture with trap, easily removable for servicing and cleaning.

C. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall supports or wall carriers and bolts.

F. Seal fixtures to wall and floor surfaces with sealant as specified in , color to match fixture.

3.4 INSTALLATION – WATER CLOSETS

A. Solidly attach water closets to floor with lag screws. Flashing is not intended hold fixture in place.

B. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.6 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.7 CLEANING

A. Clean plumbing fixtures and equipment.

3.8 PROTECTION OF FINISHED WORK

A. Do not permit use of fixtures before final acceptance.

3.9 SCHEDULES

A. Fixture Mounting Heights: Refer to Architectural Drawings and Specifications.

B. Fixture Rough-In: Refer to Drawings.

END OF SECTION

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 -- GENERAL

1.1 SUMMARY

A. Section includes single- and three-phase motors for application on equipment provided under other sections.

B. Related Sections:
   1. NONE

1.2 REFERENCES

A. American Bearing Manufacturers Association:
   1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:
   1. NEMA MG 1 - Motors and Generators.

C. International Electrical Testing Association:
   1. NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 -- PRODUCTS

2.1 PRODUCT REQUIREMENTS FOR MOTORS FURNISHED WITH EQUIPMENT

A. Three-Phase Motors: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
   1. Voltage: As indicated on Drawings.
   2. Service Factor: 1.15 or as provided by equipment manufacturer.
   3. Enclosure: Meet conditions of installation.
   4. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
   5. Insulation System: NEMA Class F for chillers, class B for pumps, fans, and other equipment.
   6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid-state control relay with wiring to terminal box.
8. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Stamp bearing sizes on nameplate.
9. Sound Power Levels: Conform to NEMA MG 1.

B. Single Phase Motors:
1. Electronically commutated (EC) type where available, otherwise use permanent split-capacitor (PSC) type motor.
2. Voltage: As indicated on Drawings, single phase, 60 Hz.

C. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 -- EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned motors.

B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

B. Install engraved plastic nameplates in accordance with Division 26.

C. Ground and bond motors in accordance with Division 26.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.15.

END OF SECTION

SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Flexible pipe connectors.
2. Expansion joints.
3. Expansion compensators.
4. Pipe alignment guides.
5. Swivel joints.
6. Pipe anchors.

B. Related Sections:
1. Section 21 05 00 – Common Work Results for Fire Suppression: Product and installation requirements for piping hangers and supports.
2. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product and installation requirements for piping hangers and supports.
3. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.
4. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product and installation requirements for vibration isolators used in piping systems.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
3. ASME B31.9 - Building Services Piping.
4. ASME BPVC Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. American Welding Society:
1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

1.3 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

B. Expansion Compensation Design Criteria:
1. Tepid Water Systems (Including Division 21 and 22)
a. Expansion:
1) Minimum Installation Temperature: 40 degrees F.
2) Maximum System Temperature: 90 degrees F.
b. Contraction:
1) Maximum Installation Temperature: 85 degrees F.
2) Minimum System Temperature: 35 degrees F.
c. Safety Factor: 30 percent.
2. Hot Water Systems (Including Division 22):
a. Installation Temperature: 40 degrees F.
b. Maximum System Temperature: 210 degrees F.
c. Safety Factor: 30 percent.
3. Refrigerant Piping Systems:
a. Liquid Line
1) Installation Temperature: 40 degrees F.

2) Maximum System Temperature: 120 degrees F.

b. Suction Line

1) Installation Temperature: 85 degrees F.

2) Minimum System Temperature: 40 degrees F.

c. Safety Factor: 30 percent.

1.4 SUBMITTALS

A. Design Data: Indicate criteria and show calculations.

B. Manufacturer's Installation Instructions: Submit special procedures.

C. Welders' Certificate: Include welders' certification of compliance with ASME BPVC Section IX, AWS D1.1/D1.1M, or equivalent.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

B. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Perform Work in accordance with ASME B31.9 (and ASME B31.1 and ASME B31.5 as applicable) code for installation of piping systems and ASME Section BPVC IX for welding materials and procedures.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

A. Furnish five-year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 -- PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Steel Piping:

1. Inner Hose: Carbon Steel or Stainless Steel.
2. Exterior Sleeve: Double braided or stainless steel.
3. Pressure Rating:
   a. Steam Systems: 125 psig WSP and 450 degrees F
   b. Hydronic, Fuel, and Refrigerant Systems: 200 psig WOG and 250 degrees F
4. Joint: As specified for pipe joints.
5. Size: Use pipe-sized units.
6. Maximum offset: 1 inch on each side of installed centerline.

B. Copper Piping:
   1. Inner Hose: Bronze
   2. Exterior Sleeve: Braided bronze.
   3. Pressure Rating:
      a. Steam Systems: 125 psig WSP and 450 degrees F
      b. Hydronic, Fuel, and Refrigerant Systems: 200 psig WOG and 250 degrees F
   4. Joint: As specified for pipe joints.
   5. Size: Use pipe sized units
   6. Maximum offset: 1 inch on each side of installed center line

C. Plastic Piping, including Polypropylene-Random (PP-R):
   1. Inner Hose: Carbon Steel or Stainless Steel.
   2. Exterior Sleeve: Double braided or stainless steel.
   3. Pressure Rating:
      a. Steam Systems: 125 psig WSP and 450 degrees F
      b. Hydronic, Fuel, and Refrigerant Systems: 200 psig WOG and 250 degrees F
   4. Joint: As specified for pipe joints.
   5. Size: Use pipe-sized units.
   6. Maximum offset: 1 inch on each side of installed centerline.

2.2 EXPANSION JOINTS

A. Single or Double Sphere, Elbow or Flexible Compensators:
   1. Body: Teflon or Neoprene and nylon.
   2. Pressure Rating:
      a. Steam Systems: 125 psig WSP and 450 degrees F
      b. Hydronic, Fuel, and Refrigerant Systems: 200 psig WOG and 250 degrees F
   3. Maximum Compression: 1 inch.
   4. Maximum Elongation: 1/2 inch.
   5. Maximum Offset: 3/4 inch.
   6. Maximum Angular Movement: 30 degrees.
   7. Joint: Galvanized flanges or unions.
   8. Size: Use pipe sized units
   9. Accessories: Control rods or control cables, as required.
   10. Application: Steel piping 2 inch and larger.

B. Copper with Packed Sliding Sleeve:
   1. Maximum Temperature: 250 degrees F.
   2. Joint: As specified for pipe joints.
   3. Size: Use pipe sized units
   4. Copper or steel piping 2 inches and larger.
   5. Application: Copper or steel piping 2 inch and larger.

2.3 ACCESSORIES

A. Pipe Alignment Guides: Two-piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1-inch thick insulation, minimum 3 inch travel.

B. Swivel Joints: Fabricated steel, bronze, ductile iron, or cast steel body, double ball bearing race, field lubricated, with rubber (Buna-N) O-ring seals.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Install Work in accordance with ASME B31.9 (and ASME B31.1 and ASME B31.5 as applicable).

B. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Refer to Section 23 05 48. Provide line size flexible connectors.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

D. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.

E. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 (or 21 05 00 or 22 05 29 as applicable) for pipe hanger installation requirements.

F. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.

3.2 MANUFACTURER'S FIELD SERVICES

A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe hangers and supports.
2. Hanger rods.
3. Hanger rods – corrosive environment.
4. Inserts.
5. Flashing.
6. Equipment curbs.
7. Sleeves.
8. Mechanical sleeve seals.
9. Formed steel channel.
10. Firestopping relating to HVAC work.
11. Firestopping accessories.
12. Equipment bases and supports.

B. Related Sections:
1. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment: Product and execution requirements for hanger and firestopping accessories.
2. Section 23 05 48 - Vibration Control for HVAC Piping and Equipment: Product and execution requirements for vibration isolators.
3. Section 23 11 13 - Facility Fuel-Oil Piping: Execution requirements for placement of hangers and supports specified by this section.
4. Section 23 11 23 - Facility Natural-Gas Piping: Execution requirements for placement of hangers and supports specified by this section.
5. Section 23 21 13 - Hydronic Piping: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:
1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Method for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method of Fire Tests of Penetration Firestop Systems.
4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

C. American Welding Society:
1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

D. FM Global:
1. FM Approvals - Approval Guide.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design Manufacturer, Selection, Application, and Installation.
2. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:

1. UL 263 - Standard for Fire Tests of Building Construction and Materials.
2. UL 723 - Standard for Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Standard for Fire Tests of Through-Penetration Firestops.
4. UL Directory – Certifications Directory - Fire–Resistance-Rated Systems and Products.

G. Intertek Testing Services (Warnock Hersey Mark):
1. WH Directory - Warnock Hersey (WH) Mark Directory.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 SUBMITTALS

A. NONE.

1.5 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Perform Work in accordance with AWS D1.1/D1.1M for welding hanger and support attachments to building structure.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Anvil International (Mueller Water Products, Inc.).
2. Carpenter & Paterson Inc.
3. Creative Systems Inc.
4. Flex-Weld, Inc.
5. Globe Pipe Hanger Products Inc.
6. Michigan Hanger Co.
7. Superior Valve Co.

B. Hydronic Piping:
1. Conform to MSS SP-69.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or carbon steel, adjustable, clevis.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.

6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, carbon steel ring.
16. Plastic Pipe Support: rubber-lined or felt-lined clamps. Tape-lined on non-clamping hangers.
17. For Exterior and Humid Areas: Furnished hot-dipped galvanized or Type 304 stainless steel or better hangers, support, and hardware.

C. Refrigerant Piping:
1. Conform to MSS SP-69.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, or Carbon steel, adjustable, clevis.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated carbon-steel ring.
10. For Exterior and Humid Areas: Furnished hot-dipped galvanized or Type 304 stainless steel or better hangers, support, and hardware.

D. Natural Gas Piping:
1. Conform to MSS SP-69.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable, clevis.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, carbon steel ring.

2.2 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 HANGER RODS – CORROSIVE ENVIRONMENT

A. Hanger Rods: 316 Stainless steel threaded both ends, threaded on one end, or continuous threaded.

2.4 INSERTS

A. Refer to Section 22 05 29.

2.5 FLASHING

A. Refer to Division 07

2.6 EQUIPMENT CURBS

A. Fabrication: Welded 18-gauge galvanized steel shell and base, mitered 3-inch cant, variable step to match roof insulation, factory installed wood nailer.

2.7 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick or Schedule 40 galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Walls: Steel pipe or 18 gage or Schedule 40 thick galvanized steel.

C. Sleeves for Pipes Through Beams and Footings: Steel pipe or 18 gage or Schedule 40 thick galvanized steel.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel.

F. Sealant: Acrylic.

2.8 MECHANICAL SLEEVE SEALS

A. Refer to Section 22 05 29.

2.9 FORMED STEEL CHANNEL

A. Refer to Section 22 05 29.

2.10 FIRESTOPPING

A. Refer to Division 07.

2.11 FIRESTOPPING ACCESSORIES

A. Refer to Division 07.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

3.2 PREPARATION

A. Obtain permission from Architect/Engineer before using powder-actuated anchors.

B. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

A. Refer to Section 22 05 29 for installation requirements.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Refer to Section 22 05 29 for installation requirements.

B. Support piping as per Schedule included in this Section.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.
   1. Gas Furnace Applications: Housekeeping pad shall 4 inches beyond the equipment footprint.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - FLASHING

A. Refer to Division 07.

3.7 INSTALLATION - SLEEVES

A. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

B. Refer to Section 22 05 29 for additional installation requirements.

3.8 INSTALLATION - FIRESTOPPING

A. Install firestopping material at fire and smoke-rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items that require firestopping.

B. Refer to Division 07.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.10 SCHEDULES

A. Pipe Hanger Spacing:

PIPE MATERIAL	MAXIMUM HORIZONTAL SPACING Feet	MAXIMUM VERTICAL SPACING Feet
ABS pipe	4	10 (note 2)
Aluminum pipe and tubing	10	15
Brass pipe	10	10
Brass tubing, 1-1/4-inch diameter and smaller	6	10
Brass tubing, 1-1/2-inch diameter and larger	10	10
Cast-iron pipe	5 (note 1)	15
Copper or copper-alloy pipe	12	10
Copper or copper-alloy tubing, 1-1/4-inch diameter and smaller	6	10
Copper or copper-alloy tubing, 1-1/2-inch diameter and larger	10	10
CPVC pipe or tubing, 1 inch and smaller	3	10 (note 2)
CPVC pipe or tubing, 1-1/4-inch and larger	4	10 (note 2)
Lead pipe	Continuous	4
PB pipe or tubing	32 inches	4
PEX tubing	32 inches	10 (note 2)

Polypropylene (PP) pipe or tubing, 1 inch or smaller	32 inches (note 3)	10 (note 2)
Polypropylene (PP) pipe or tubing, 1-1/4-inch or larger	4 (note 3)	10 (note 2)
PVC pipe	4	10
Steel tubing	8	10
Steel pipe	12	15

B. Note 1: The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.

C. Note 2: Mid-story guide (sliding point) required.

D. Note 3: Hanger spacing may be increased per piping manufacturer's installation instructions.

END OF SECTION

SECTION 23 05 48 - VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Inertia bases.
2. Vibration isolators.
3. Duct silencers.
4. Acoustic housings.

B. Related Sections:
1. Section 21 05 00 – Common Work Results for Fire Suppression: Product requirements for pipe hangers and supports.
2. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports.
3. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping: Product requirements for anchors and piping expansion compensation.
4. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
5. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Requirements for sound and vibration measurements performed independent of this section.
6. Section 23 33 00 - Air Duct Accessories: Product requirements for both solid and flexible duct connectors for duct silencers specified for placement by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:
1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

B. American National Standards Institute:
1. ANSI S1.4 - American National Standard Specification for Sound Level Meters.
2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
3. ANSI S1.13 - Measurement of Sound Pressure Levels in Air.
4. ANSI S12.60 – American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools.

C. Air Conditioning, Heating, & Refrigeration Institute:
1. AHRI 575 - Method of Measuring Machinery Sound Within an Equipment Space.

D. American Society of Heating, Refrigerating and:
1. ASHRAE 68 - Laboratory Method of Testing to Determine the Sound Power in a Duct.
2. ASHRAE Handbook - HVAC Applications.

E. ASTM International:
1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
3. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

F. International Organization for Standardization:
1. ISO 3747 - Determination of Sound Power Levels and Sound Energy Levels of Noise Sources Using Sound Pressure - Engineering/Survey Methods for use in Situ in a Reverberant Environment.

G. Sheet Metal and Air Conditioning Contractors':
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping and ductwork.

B. Provide minimum static deflection of isolators for equipment per Vibration Isolation Schedule at end of Section.

C. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.

D. Maintain rooms at following maximum sound levels, in Room Criteria (RC) as defined by ASHRAE Handbook., HVAC Applications and ANSI S1.8. See Room Sound Level Schedule at end of Section.

1.5 SUBMITTALS

A. Shop Drawings: Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of hangers including attachment points.

1.7 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Perform Work in accordance with ANSI S1.13 and AHRI 575 standards and recommendations of ASHRAE 68.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 INERTIA BASES

A. Selection:
   1. Specific equipment base requirements per Base Schedule at the end of this Section.

B. No Base (Type A):
   1. Construction: Isolators attached directly to equipment.

C. Structural Bases (Type B):
   1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
   2. Construction: Welded structural steel with gusset brackets, supporting equipment and motor with motor slide rails.

D. Concrete Inertia Bases (Type C):

1. Mass: Minimum of 1.5 times weight of isolated equipment.
2. Construction: Structured steel channel perimeter frame, with gusset brackets and anchor bolts, adequately reinforced, concrete filled.
3. Connecting Point: Reinforced to connect isolators and snubbers to base.
4. Concrete: Reinforced 3,000-psi concrete.

E. Curb-Mounted Base (Type D):
1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
2. Construction: Welded structural steel with gusset brackets, supporting equipment, with watertight assembly. Airside equipment shall have airtight assembly.
3. Coordination: Coordinate size and location with architectural roof curb.

2.2 VIBRATION ISOLATORS

A. Selection:
1. Specific equipment isolator and deflection requirements per Isolator Schedule at the end of this Section.

B. Neoprene Pad Isolators (Type 1):
1. Rubber or neoprene-waffle pads.
a. 30 durometer minimum.
b. Minimum 1/2 inch thick.
c. Maximum loading 40 psi.
d. Height of ribs: not to exceed 0.7 times width.
2. Configuration: Single layer or 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.

C. Glass Fiber Pads (Type 1): Neoprene jacketed pre-compressed molded glass fiber.

D. Rubber Mount or Hanger (Type 2): Molded rubber with threaded insert.

E. Open Spring Isolators (Type 3):
1. Spring Isolators:
a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25-inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

F. Closed Spring Isolators (Type 3):
1. Spring Isolators:
a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25-inch clearance.

G. Spring Hanger (Type 3):

1. Spring Isolators:
    a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
    b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators or rubber hanger with threaded insert.
4. Misalignment: Capable of 20-degree hanger rod misalignment.

H. Restrained Spring Isolators (Type 4):
1. Spring Isolators:
    a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
    b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25-inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Furnish mounting frame and limit stops.

I. Restrained Closed Spring Isolators (Type 4):
1. Spring Isolators:
    a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
    b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25-inch clearance and limit stops.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify equipment, ductwork and piping is installed before work in this section is started.

3.2 EXISTING WORK

A. Provide access to existing piping and ductwork and other installations remaining active and requiring access.

B. Extend existing piping and ductwork installations using materials and methods.

3.3 INSTALLATION – VIBRATION ISOLATION

A. Install isolation for motor driven equipment.

B. Adjust equipment level.

C. Install spring hangers without binding.

D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

F. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.

G. Support piping connections to isolated equipment resiliently as follows:
   1. Suspended piping: All piping in mechanical rooms and within 50 feet of vibration-isolated equipment.
   2. Select three hangers closest to vibration source for minimum static deflection equivalent to isolated equipment deflection, with a 2-inch maximum. Select remaining isolators for minimum 0.75-inch static deflection.
   3. Suspended piping: Suspended below or within 50 feet of noise-sensitive areas.

H. Piping over 2-inch diameter suspended below or within 50 feet of noise-sensitive areas shall be hung with isolation hangers.

3.4 SCHEDULES

A. Room Sound Level:

Room Types	Description	Noise/Room Criterion (NC/RC)
Office Buildings	Executive and private offices	30
	Conference rooms	30
	Teleconference rooms	25
	Open-plan offices	40
	Corridors and lobbies	40
Laboratories	Testing/research with minimal speech communication	50
	Extensive phone use and speech communication	45
	Group teaching	35

B. Pipe Isolation Schedule:

Pipe Size Inch	Isolated Distance from Equipment diameters
1	120
2	90 diameters
3	80 diameters
4	75 diameters
6	60 diameters
8	60 diameters

C. Equipment Isolation Schedule:

Isolated Equipment	Slab on Grade		Floor Span Up to 20 ft		Floor Span 20 to 30 ft		Floor Span 30 to 40 ft	
	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)
Chillers & Refrigeration Machines								
Reciprocating	A-2	0.25	A-4	0.75	A-4	1.50	A-4	2.50
Centrifugal, scroll	A-1	0.25	A-4	0.75	A-4	1.50	A-4	1.50
Air Compressors and Vacuum Pumps								
Tank-mounted horz., ≤ 10 HP	A-3	0.75	A-3	0.75	A-3	1.50	A-3	1.50
Tank-mounted horz., ≥ 15 HP	C-3	0.75	C-3	0.75	C-3	1.50	C-3	1.50
Tank-mounted vert.	C-3	0.75	C-3	0.75	C-3	1.50	C-3	1.50
Base-mounted	C-3	0.75	C-3	0.75	C-3	1.50	C-3	1.50
Large reciprocating	C-3	0.75	C-3	0.75	C-3	1.50	C-3	1.50
Pumps								
Closed-coupled, ≤ 7.5 HP	B-2	0.25	C-3	0.75	C-3	0.75	C-3	0.75
Closed-coupled, ≥ 10 HP	C-3	0.75	C-3	0.75	C-3	1.50	C-3	1.50
Inline, ≤25 HP	A-3	0.75	A-3	1.50	A-3	1.50	A-3	1.50
Inline, ≥30 HP	A-3	1.50	A-3	1.50	A-3	1.50	A-3	2.50
Boilers								
Fire-tube	A-1	0.25	B-4	0.75	B-4	1.50	B-4	2.50
Water-tube, copper fin	A-1	0.12	A-1	0.12	A-1	0.12	B-4	0.25
Axial Fans, Plenum Fans, Cabinet Fans, Fan Sections, Centrifugal Inline Fans								
≤ 22-inch diameter	A-2	0.25	A-3	0.75	A-3	0.75	C-3	0.75
≥ 24-inch diameter, ≤ 2-in. SP HP, ≤300 RPM	B-3	2.50	C-3	3.50	C-3	3.50	C-3	3.50
≥ 24-inch diameter, ≤ 2-in. SP, 301 to 500 RPM	B-3	0.75	B-3	1.50	C-3	2.50	C-3	2.50
≥ 24-inch diameter, ≤ 2-in. SP HP, ≥ 500 RPM	B-3	0.75	B-3	1.50	B-3	2.50	B-3	2.50
≥ 24-inch diameter, > 2-in. SP, ≤ 300 RPM	C-3	2.50	C-3	3.50	C-3	3.50	C-3	3.50
≥ 24-inch diameter, > 2-in. SP, 301 to 500 RPM	C-3	1.50	C-3	1.50	C-3	2.50	C-3	2.50

Isolated Equipment	Slab on Grade		Floor Span Up to 20 ft		Floor Span 20 to 30 ft		Floor Span 30 to 40 ft	
	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)
≥ 24-inch diameter, > 2-in. SP, ≥ 500 RPM	C-3	0.75	C-3	1.50	C-3	1.50	C-3	2.50
Centrifugal Fans								
≤ 22-inch diameter	B-2	0.25	B-3	0.75	B-3	0.75	B-3	1.50
≥ 24-inch diameter, ≤ 40 HP, ≤ 300 RPM	B-3	2.50	B-3	3.50	B-3	3.50	B-3	3.50
≥ 24-inch diameter, ≤ 40 HP, 301 to 500 RPM	B-3	0.75	B-3	1.50	B-3	2.50	B-3	2.50
≥ 24-inch diameter, ≤ 40 HP, ≥ 500 RPM	B-3	0.75	B-3	0.75	B-3	0.75	B-3	1.50
≥ 24-inch diameter, ≥ 50 HP, ≤ 300 RPM	C-3	2.50	C-3	3.50	C-3	3.50	C-3	3.50
≥ 24-inch diameter, ≥ 50 HP, 301 to 500 RPM	C-3	1.50	C-3	1.50	C-3	2.50	C-3	2.50
≥ 24-inch diameter, ≥ 50 HP, ≥ 500 RPM	C-3	1.00	C-3	1.50	C-3	1.50	C-3	2.50
Propeller Fans								
Wall-mounted	A-1	0.25	A-1	0.25	A-1	0.25	A-1	0.25
Roof-mounted	A-1	0.25	A-1	0.25	B-4	1.50	D-3	3.50
Heat Pumps, Fan-Coils, Computer Room Units								
All	A-3	0.75	A-3	0.75	A-3	0.75	A/D-3	1.50
Condensing Units								
All	A-1	0.25	A-4	0.75	A-4	1.50	A/D-4	1.50
Packaged AH, AC, H, and V Units								
≤ 10 HP	A-3	0.75	A-3	0.75	A-3	0.75	A-3	0.75
≤ 15 HP *and* ≤ 4-in. SP, ≤ 300 RPM	A-3	0.75	A-3	3.50	A-3	3.50	C-3	3.50
≤ 15 HP *and* ≤ 4-in. SP, 301 to 500 RPM	A-3	0.75	A-3	2.50	A-3	2.50	A-3	2.50
≤ 15 HP *and* ≤ 4-in. SP, ≥ 500 RPM	A-3	0.75	A-3	1.50	A-3	1.50	A-3	1.50
≥ 15 HP *or* ≥ 4-in. SP, ≤ 300 RPM	B-3	0.75	C-3	3.50	C-3	3.50	C-3	3.50

Isolated Equipment	Slab on Grade		Floor Span Up to 20 ft		Floor Span 20 to 30 ft		Floor Span 30 to 40 ft	
	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)	Base & Isolator Type[1]	Min. Defl. (In.)
≥ 15 HP *or* ≥ 4-in. SP, 301 to 500 RPM	B-3	0.75	C-3	1.50	C-3	2.50	C-3	2.50
≥ 15 HP *or* ≥ 4-in. SP, ≥ 500 RPM	B-3	0.75	C-3	1.50	C-3	1.50	C-3	2.50
Packaged Rooftop Equipment								
All	A-1	0.25	A-4	0.75	A-4	1.50	A/D-4	1.50
Ducted Rotating Equipment – Small Fans, Fan-Powered Boxes								
≤ 600 CFM	A-3	0.50	A-3	0.50	A-3	0.50	A-3	0.50
> 600 CFM	A-3	0.75	A-3	0.75	A-3	0.75	A-3	0.75
Engine-Driven Generators								
All	A-3	0.75	C-3	1.50	C-3	2.50	C-3	3.50

Note 1: Base type and isolator type correspond with equipment listed in Part 2 of this Section.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Sections:
1. NONE.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 SUBMITTALS

A. NONE.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

C. Verify painting is complete where applicable per Section 09 97 20 prior to installation of identification for piping and equipment.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:
   1. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches square.

B. Metal Tags:
   1. Brass, Aluminum, or Stainless Steel with stamped letters; tag size minimum 1-1/2 inches square with finished edges.

C. Information Tags:
   1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

D. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum or plastic laminated frame.

2.3 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
   1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
   2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
   3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
   4. Ductwork and Equipment: 1-3/4 inches high letters.

B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PLASTIC MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Markers:
   1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Markers:
   1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Plastic Underground Markers:
   1. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4-mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

A. Description: Steel or plastic with 3/4 inch diameter color-coded head.

B. Color code as approved by Owner. If no preference by Owner, color as follows:
   1. HVAC equipment (including terminal boxes): Yellow.
   2. Fire dampers/smoke dampers: Red.
   3. Plumbing valves: Green.
   4. Heating/cooling valves: Blue.

C. Contractor Option: Adhesive stickers may be used in lieu of tacks.

2.6 LABELS

A. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:
   1. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:
   1. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 -- EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags using corrosion resistant chain. Number tags consecutively by location.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify zone dampers and valves with numbered tags corresponding to Drawings.

J. Identify space temperature sensors with tags indicating HVAC unit served.

K. Tag automatic controls, instruments, and relays. Key to control schematic.

L. Identify piping, concealed or exposed, with plastic markers, or plastic tape markers,.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification:
      a. Not to exceed 20 feet on straight runs including risers and drops.
      b. Adjacent to each valve and tee.
      c. At each side of penetration of structure or enclosure.
      d. At each obstruction.

M. Identify ductwork with plastic tape markers.
   1. Identify with air handling unit identification number, area served, and flow direction.
   2. Locate identification:
      a. At air handling unit.
      b. At each side of penetration of structure or enclosure.
      c. At each obstruction.

N. Provide ceiling tacks to locate valves, dampers, and terminal boxes above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Testing, adjusting, and balancing of air systems.
   2. Testing, adjusting, and balancing of hydronic systems.
   3. Measurement of final operating condition of HVAC systems.

B. Related Sections:
   1. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation for HVAC equipment.

1.2 REFERENCES

A. Associated Air Balance Council:
   1. AABC - National Standards for Total System Balance.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
   1. ASHRAE 111 - Measurement, Testing, Adjusting and Balancing of Building HVAC Systems.

C. Natural Environmental Balancing Bureau:
   1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

D. Testing, Adjusting and Balancing Bureau:
   1. TABB – International Standards for Environmental Systems Balance.

1.3 SYSTEM DESCRIPTION

A. The Work in this Section shall be by the Testing and Balancing Contractor (TAB) as a sub-contractor to the Mechanical Contractor. The TAB shall be a third party to the Mechanical Contractor.

B. Existing Buildings: The Scope of TAB Work is to include the entire building, including areas labeled as Not-In-Contract in the Drawings.

1.4 SUBMITTALS

A. Test Reports: Indicate data on AABC, ASHRAE 111, NEBB, or TABB/SMACNA Report forms.

B. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

C. Furnish reports in soft cover, letter size manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of flow measuring stations, balancing valves, and rough setting.

B. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Perform Work in accordance with AABC, ASHRAE 111, NEBB, or TABB standards.

C. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

1.7 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years documented experience certified by AABC, NEBB, or TABB.

1.8 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.9 WARRANTY

A. Provide warranty for period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10% of total number of terminals, or resetting of any outlet, coil, or device listed in the test report.

B. Warranty shall meet the requirements of the following programs:
1. AABC – National Project Performance Guarantee
2. NEBB – Conformance Certification
3. TABB – International Quality Assurance Program

PART 2 -- PRODUCTS

2.1 NONE

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to verify required balancing devices are shown and in accessible locations.

B. Examine approved HVAC system equipment submittals.

C. Verify systems are complete and operable before commencing work. Verify the following:
1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus 10 or minus 5 percent of design.
   1. Outside air shall NOT be less than the design value.

B. Air Outlets and Inlets:
   1. Total for Space: Adjust to within plus 10 or minus 5 percent of design.
   2. Each Inlet and Outlet: Adjust to within plus 10 or minus 5 percent of design.

C. Hydronic Systems: Adjust to within plus 10 or minus 5 percent of design.

3.4 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
   1. Fans with VFDs: Lockout resonant frequencies that generate excessive noise or vibration. Refer to Section 23 05 53.
   2. Belt Driven Fans: Provide sheave drive changes to vary fan speed.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries.

L. Calibrate variable frequency drives and static pressure setpoint for units.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:
   1. Plumbing Pumps.
   2. Forced Air Furnaces.
   3. Air Cooled Refrigerant Condensers.
   4. Air Coils.
   5. Makeup Air Units.
   6. Fans.
   7. Air Filters.
   8. Air Inlets and Outlets.

B. Report Forms
   1. Title Page:
      a. Name of Testing, Adjusting, and Balancing Agency
      b. Address of Testing, Adjusting, and Balancing Agency
      c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
      d. Project name
      e. Project location
      f. Project Architect
      g. Project Engineer
      h. Project Contractor
      i. Project altitude
      j. Report date
   2. Summary Comments:
      a. Design versus final performance
      b. Notable characteristics of system
      c. Description of systems operation sequence
      d. Summary of outdoor and exhaust flows to indicate building pressurization
      e. Nomenclature used throughout report
      f. Test conditions

3. Instrument List:
    a. Instrument
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Range
    f. Calibration date
4. Electric Motors:
    a. Manufacturer
    b. Model/Frame
    c. HP/BHP and kW
    d. Phase, voltage, amperage; nameplate, actual, no load
    e. RPM
    f. Service factor
    g. Starter size, rating, heater elements
    h. Sheave Make/Size/Bore
5. V-Belt Drive:
    a. Identification/location
    b. Required driven RPM
    c. Driven sheave, diameter and RPM
    d. Belt, size and quantity
    e. Motor sheave diameter and RPM
    f. Center to center distance, maximum, minimum, and actual
6. Pump Data:
    a. Identification/number
    b. Manufacturer
    c. Size/model
    d. Impeller
    e. Service
    f. Design flow rate, pressure drop, BHP and kW
    g. Actual flow rate, pressure drop, BHP and kW
    h. Discharge pressure
    i. Suction pressure
    j. Total operating head pressure
    k. Shut off, discharge and suction pressures
    l. Shut off, total head pressure
7. Heat Exchanger:
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Model number
    f. Serial number
    g. Steam pressure, design and actual
    h. Primary water entering temperature, design and actual
    i. Primary water leaving temperature, design and actual
    j. Primary water flow, design and actual
    k. Primary water pressure drop, design and actual
    l. Secondary water leaving temperature, design and actual
    m. Secondary water leaving temperature, design and actual
    n. Secondary water flow, design and actual
    o. Secondary water pressure drop, design and actual
8. Heating Coil Data:

a. Identification/number
b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Water flow, design and actual
g. Water pressure drop, design and actual
h. Entering water temperature, design and actual
i. Leaving water temperature, design and actual
j. Entering air temperature, design and actual
k. Leaving air temperature, design and actual
l. Air pressure drop, design and actual

9. Return Air/Outside Air Data:
   a. Identification/location
   b. Design air flow
   c. Actual air flow
   d. Design return air flow
   e. Actual return air flow
   f. Design outside air flow
   g. Actual outside air flow
   h. Return air temperature
   i. Outside air temperature
   j. Required mixed air temperature
   k. Actual mixed air temperature
   l. Design outside/return air ratio
   m. Actual outside/return air ratio
10. Exhaust Fan Data:
   a. Location
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Air flow, specified and actual
   f. Total static pressure (total external), specified and actual
   g. Inlet pressure
   h. Discharge pressure
   i. Sheave Make/Size/Bore
   j. Number of Belts/Make/Size
   k. Fan RPM
11. Duct Traverse:
   a. System zone/branch
   b. Duct size
   c. Area
   d. Design velocity
   e. Design air flow
   f. Test velocity
   g. Test air flow
   h. Duct static pressure
   i. Air temperature
   j. Air correction factor

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Piping system insulation.
2. Equipment insulation.
3. Pipe insulation jackets.
4. Equipment insulation jackets.
5. Insulation accessories including vapor retarders and accessories.
6. Ductwork insulation.
7. Ductwork insulation jackets.
8. Duct liner.
9. Insulation accessories including vapor retarders and accessories.
10. Blower discharge piping.

B. Related Sections:
1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and Execution requirements for inserts at hanger locations.
2. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for HVAC piping and equipment identification.

1.2 REFERENCES

A. ASTM International:
1. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
2. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
3. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
4. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
5. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
6. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
7. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
8. ASTM E84 – Standard for Test for Surface Burning Characteristics of Building Materials.
9. ASTM E96/E96M - Standard Test Method for Water Vapor Transmission of Materials.

B. Sheet Metal and Air Conditioning Contractors' National Association:
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. National Fire Protection Association (NFPA).

D. Underwriter's Laboratories (UL).
1. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

E. 2024 MN Commercial Energy Code.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 SUBMITTALS

A. Product Data: Submit product description, thermal characteristics, and list of materials and thickness for each service, and location.

1.5 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature during and after installation for minimum period as recommended by manufacturer.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Armacell, LLC (Armaflex).

B. Aeroflex USA, Inc.

C. K-Flex USA.

D. Johns Manville.

E. Knauf Insulation.

F. Owens-Corning.

2.2 SURFACE BURNING CHARACTERISTICS

A. For all insulation and related materials, provide UL Classified products per UL 723 and/or meeting ASTM E84, by a testing agency acceptable to the authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

B. Insulation Installed Indoors: Flame spread index of 25 or less, and smoke developed index of 50 or less.

C. Insulation Installed Outdoors: Flame spread index of 75 or less, and smoke developed index of 150 or less.

2.3 PIPE: MAN MADE MINERAL FIBER

A. Insulation: ASTM C547 Mineral Fiber Pipe Insulation, Type I, 805 degrees F.

B. Applications on Austenitic stainless steel: Conform to ASTM C795.

C. Vapor Retarder Jacket:
   1. White Kraft paper with glass fiber yarn, bonded to aluminized film.
   2. Moisture vapor transmission: ASTM E96/E96M; 0.02 perm-inches.

D. Vapor Retarder Lap Adhesive:
   1. Compatible with insulation.

2.4 DUCT: MINERAL FIBER, FLEXIBLE

A. Insulation: ASTM C553 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications, Type II.

B. Vapor Retarder Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture vapor transmission: ASTM E96/E96M; 0.02 perms.
   3. Secure with pressure sensitive tape.

C. Vapor Retarder Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.

2.5 DUCT: MINERAL FIBER, RIGID

A. Insulation: ASTM C612 Mineral Fiber Block and Board Insulation, Type IA.

B. Vapor Retarder Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture vapor transmission: ASTM E96/E96M; 0.04 perms.
   3. Secure with pressure sensitive tape.

C. Vapor Retarder Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.

D. Indoor Vapor Retarder Finish:
   1. Cloth: Untreated; 9 oz./sq. yd weight, glass fabric.
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.6 REFRIGERANT PIPE: ELASTOMERIC CELLULAR FOAM

A. Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form: ASTM C534/C534M; Type I, Tubular form.

B. Elastomeric Foam Adhesive:
   1. Air-dried, contact adhesive, compatible with insulation.

2.7 JACKETS: PIPE INSULATION AND EQUIPMENT

A. PVC Plastic Pipe Jacket:
   1. Product Description: One-piece molded type fitting covers and sheet material, off-white color.
   2. Thickness: 10 mil.
   3. Connections: Brush on welding adhesive.

B. Covering Adhesive Mastic:
   1. Compatible with insulation.

2.8 DUCT LINER: ELASTOMERIC CELLULAR FOAM

A. Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form: ASTM C534/C534M; Type I, Tubular form

B. Elastomeric Foam Adhesive:
   1. Air-dried, contact adhesive, compatible with insulation.

2.9 BLOWER DISCHARGE PIPING

A. Blower pipe insulation:

   1. Thermafiber metal mesh blankets, preformed mineral felt sandwiched between metal facings, formed to fit curved surface.

   2. 8 lb. cu. ft. density, with 1" hex wire mesh both sides.

   3. Thickness to be 2", applied in 1/2" increments.

2.10 DUCT LINER: GLASS FIBER

A. Insulation: ASTM C1071 Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material), Type II.

B. Adhesive:
   1. Waterproof type.

C. Liner Fasteners: Galvanized steel.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify piping, equipment and ductwork has been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING

A. Exposed Piping: Locate insulation and cover seams in least visible locations.

B. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

C. Manmade mineral fiber insulated pipes conveying fluids below ambient temperature:
   1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

E. Manmade mineral fiber insulated pipes conveying fluids above ambient temperature:
   1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

F. Inserts and Shields:
   1. Application: Piping or Equipment 2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under finish jacket.
4. Insert configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be site fabricated or factory fabricated.
5. Insert material: Compression resistant insulating material suitable for planned temperature range and service.

G. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.

H. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.

I. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel, or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

3.3 INSTALLATION - EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

D. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

E. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

F. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

G. Mineral fiber insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor retarder, factory-applied or field-applied. Finish with glass cloth and adhesive.

H. Finish insulation at supports, protrusions, and interruptions.

I. Nameplates and ASME Stamps: Bevel and seal insulation around. Do not insulate over.

J. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.4 INSTALLATION - DUCTWORK

A. Insulated ductwork conveying air below ambient temperature:
1. Provide insulation with vapor retarder jackets.
2. Finish with tape and vapor retarder jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

B. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor retarder jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

C. External Duct Insulation Application:
1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
2. Secure insulation without vapor retarder with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

D. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.5 SCHEDULES

A. Piping:
1. Cooling Systems:
a. Condensate Drains from Cooling Coils:
1) Man Made Mineral Fiber Insulation, 1-inch thick.
b. Refrigerant Suction: Elastomeric cellular foam – twin-tube, 1-inch thick.
c. Refrigerant Hot Gas: Elastomeric cellular foam – twin-tube, 1-inch thick.
2. Other Systems:
a. Condensate Drains from Combustion Equipment: Not Required.

SCHEDULE OF MINIMUM PIPE INSULATION THICKNESS (IN INCHES)					
Fluid Design Operating Temp Range	Nominal Pipe or Tube Size, in.				
	<1	1 – <1-1/2	1-1/2 – <4	4 - <8	=>8
Heating Systems (Steam, Steam Condensate, Hot Water)					
>350	4.5	5.0	5.0	5.0	5.0
251 – 350	3.0	4.0	4.5	4.5	4.5
201 – 250	2.5	2.5	2.5	3.0	3.0
141 – 200	1.5	1.5	2.0	2.0	2.0
105 – 140	1.0	1.0	1.5	1.5	1.5
<105	0.5	0.5	1.0	1.0	1.0
Cooling Systems (Refrigerant)					
>60	0.5	0.5	0.5	0.5	1.0
40 – 60	0.5	0.5	1.0	1.0	1.0
<40	0.5	1.0	1.0	1.0	1.5

B. Equipment:
1. Hydronic System Equipment:
a. Material: Elastomeric Cellular Foam.
1) Thickness: Per pipe insulation schedule. Select for rated temperature range with 2-inch equivalent pipe.
2) Applicable Equipment:
a) Air Separators.

C. Ductwork:
   1. Supply and Return Ducts:
      a. Insulation:
         1) Material: Rigid (exposed, mech rooms) or flexible (concealed) glass fiber ductwork insulation.
         2) Thickness: Per Duct Insulation Schedule included in this Section.
         3) Vapor Retarder: Per Duct Insulation Schedule included in this Section.
         4) Weatherproof Barrier: Per Duct Insulation Schedule included in this Section.
   2. Transfer Air Duct:
      a. Duct Liner Material: Elastomeric cellular foam or glass fiber internal duct liner.
      b. Thickness: 1 inch thick.
   3. Combustion Air Duct:
      a. Insulation Material: Rigid glass fiber ductwork insulation.
      b. Thickness: 1-1/2 inches thick.
      c. Vapor Retarder: Required.
   4. Exhaust and Relief Ducts:
      a. Within 10 feet of Exterior Openings:
         1) Insulation Material: Flexible glass fiber ductwork insulation.
         2) Thickness: Per Duct Insulation Schedule included in this Section.
         3) Vapor Retarder: Required.
      b. Exposed to Outdoor Air:
         1) Insulation Material: Rigid glass fiber ductwork insulation.
         2) Thickness: Per Duct Insulation Schedule included in this Section.
         3) Vapor Retarder: Required.
         4) Weatherproof Barrier: Required.
      c. Other Exhaust Duct Locations:
         1) Insulation not required.
   5. Outside Air Intake Ducts:
      a. Shall be provided where indicated on drawings:
         1) Insulation Material: Rigid glass fiber ductwork insulation.
         2) Thickness: 1-1/2 inches thick.
         3) Vapor Retarder: Required.

MINIMUM REQUIRED DUCT INSULATION			
Duct Location	Supply Duct	Return Duct	Exhaust Duct
Exterior	R-12.0, V, W	R-12.0, V, W	R-12.0, V, W
Attics	R-12.0, V	R-12.0, V	R-6.0, V
Duct to Space delta-T: >40 degrees F	R-5.0, V	-	R-5.0, V
Duct to Space delta-T: 15-40 degrees F	R-3.3, V	-	R-3.3, V
Duct to Space delta-T: <15 degrees F	-	-	-
Within Conditioned Spaces	NOTE 3	-	-
Notes:			
1: V indicated Vapor Retarder			
2: W indicates Weatherproof Barrier			
3: If supply air temperature rise is greater than 3 degrees F, duct insulation is required.			

END OF SECTION

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SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Relative humidity sensors.
2. Temperature sensors.
3. Momentary push button switch.
4. Windup timer switch.
5. Pressure transmitters.
6. Pressure sensors.
7. Filter status monitoring transmitters.
8. Control air dampers.
9. Control valves.
10. Electric damper actuators.
11. Transformers.
12. Alarm indication stations.
13. Freeze stats.
14. Variable frequency drives.
15. Gas Monitoring Sensor.

B. Related Sections:
1. Section 23 05 13 – Common Motor Requirements for HVAC Equipment: Product requirements for electric motors.
2. Section 23 09 93 – Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
3. Section 23 21 16 – Hydronic Piping Specialties: Product requirements for thermometer sockets.
4. Section 23 33 00 – Air Duct Accessories: Product requirements for duct mounted thermometers.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:
1. AMCA 500 – Laboratory Methods of Testing Louvers for Rating.

B. American Society of Mechanical Engineers:
1. ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

C. ASTM International:
1. ASTM B32 – Standard Specification for Solder Metal.
2. ASTM B280 – Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
3. ASTM D1693 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

D. Federal Communications Commission:
1. FCC Part 15.

E. National Electrical Manufacturers Association:
1. NEMA DC 3 – Residential Controls - Electrical Wall-Mounted Room Thermostats.

F. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

G. National Institute of Standards and Technology:
1. NIST – Policy on Traceability.

H. Underwriters Laboratory, Inc.:
   1. UL-873 – Temperature Reading and Indicating Equipment.
   2. UL 60730-1, 60730-2-9, Automated Electrical Controls.

1.3 SUBMITTALS

A. Shop Drawings: Indicate operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Coordinate submittals with information requested in Section 23 09 93.

B. Product Data: Submit description and engineering data for each control system component. Include sizing as requested.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors.

B. Operation and Maintenance Data: Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.5 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Control Air Damper Performance: Test in accordance with AMCA 500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept controls on site in original factory packaging Inspect for damage.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

   1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72 hour battery backup.

   2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostic; monitor system and report results.

   3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.2 TEMPERATURE SENSORS

A. Manufacturers:
   1. Automatic Components, Inc. (ACI).
   2. Veris Industries.
   3. MAMAC Systems, Inc.

B. Electronic Room Temperature Sensor:
   1. Type: NEMA DC 3, 24 volts or 120 volts.
   2. Performance: Minimum accuracy of 0.36 degrees F, minimum stability of 0.23 degrees F.
   3. Service: cooling and heating.
   4. Covers: Locking with concealed setpoint.
   5. Features:
      a. Temperature signal.
      b. Temperature set point adjustment knob/wheel.
      c. Occupancy override button.

C. Room Temperature Sensor Accessories:
   1. Insulating Bases: For sensors located on exterior walls.
   2. Thermostat Guards: Metal or locking transparent plastic mounted on separate base.

D. Immersion Well Sensor:
   1. Stainless steel immersion well for fluid temperature sensors. Wells must be filled with heat transfer compound. Provide pipe fittings and adaptors as required to allow proper sensing of fluid temperature in main pipe..
   2. Length: As required for proper fluid sensing.

E. Air-stream Sensor:
   1. Provide appropriate length probe sensor for duct size with NEMA type 1 enclosure.

F. Averaging Sensor:
   1. Provide a 24-foot averaging sensor with sensing elements every 3 feet minimum. Sensor must provide 75% coil area coverage; provide longer lengths as required.

2.3 MOMENTARY PUSH BUTTON SWITCH

A. Manufacturers:
   1. Kele
   2. ACI
   3. Mamac
   4. IDEC

B. Push button:
   1. Contact Rating 10A, 600 VAC/VDC; 5mA, 3 VAC/VDC minimum
   2. Electrical Life 500,000 minimum operations
   3. Approvals UL listed, File #E68961; CSA certified, File #LR48366
   4. Stainless steel wall plate box.
   5. Button size: 2.4 cm.
   6. Use indicator: Provide switch label indicating usage and duration.

2.4 WINDUP TIMER SWITCH

A. Manufacturers:
   1. Intermatic.
   2. Kele.
   3. MAMAC.

B. Timer
   1. Spring wound.

2. Length of time: Refer to sequence of operations for timer length.
3. Plate: stainless steel.

2.5 PRESSURE TRANSMITTERS

A. Manufacturers:
1. Automatic Components, Inc. (ACI).
2. Veris Industries.
3. MAMAC Systems, Inc.
4. Dwyer Instruments, Inc.
5. Siemens Industry, Inc.

B. Provide where required by the Sequence of Operation. Refer to Section 23 09 93.

C. Differential pressure transmitters shall be solid state suitable for the measured medium, range and pressures of the application, with adjustable span and zero, and accuracy of plus or minus one percent of the span.

D. Static pressure transmitters shall be solid-state piezoresistive silicon suitable for the measured medium, range and pressures of the application, with adjustable span and zero, and accuracy of plus or minus one percent of the span, linearity and hysteresis of plus or minus 0.1 percent of span, and repeatability of 0.25 percent of span.

E. Velocity pressure transmitters shall be solid state suitable for the measured medium, range and pressures of the application, with adjustable span and zero, and accuracy of plus or minus one percent of the span.

F. Analog Output Transducers shall be designed for precision closed loop control with pneumatic repeatability error no greater than one percent.

2.6 PRESSURE SENSORS FOR BUILDING STATIC PRESSURE

A. Outdoor pickup sensor shall be Dwyer A-306-A or approved equal, and shall connect to a building static pressure transmitter.

B. Indoor pickup sensor shall be Dwyer A418 or approved equal, and shall connect to a building static pressure transmitter.

2.7 FILTER STATUS MONITORING TRANSMITTER

A. Manufacturers:
1. Automatic Components, Inc. (ACI).
2. Veris Industries.
3. MAMAC Systems, Inc.
4. Dwyer Instruments, Inc.

B. Applies to all air handling units, and filter banks except terminal boxes.

C. Each system with filters shall have one differential pressure sensor across each filter bank. This sensor shall provide an analog output to the BAS to remind operator to change the filters. These include any equipment with filter banks.

D. Alarms shall be programmed to indicate when air pressure across filters exceeds the recommended dirty filter set point.

E. Clean filter losses shall be obtained from measurements at any equipment with filter banks.

2.8 CONTROL AIR DAMPERS

A. Refer to Section 23 33 00. Provided by Mechanical Contractor.

2.9 CONTROL VALVES - BALL

A. Manufacturer:
   1. Belimo Aircontrols, Inc.
   2. Schneider Electric. Model: DuraDrive Series.
   3. Nexus Valve.
   4. Siemens Industry, Inc.
   5. Bray International.

B. Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system unless otherwise indicated. Provide valves with configurations and flow rates as indicated on drawings. Stem and ball shall be stainless steel. Close off pressure shall be 125 psi or greater per valve.

C. Sizing: 3 psig maximum pressure drop at design flow rate.

D. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

E. Open/Closed control signal.
   1. Applicable Equipment:
      a. Make-up Air Unit heating.
      b. Unit heaters / Convectors.

2.10 ELECTRIC DAMPER ACTUATORS

A. Manufacturers:
   1. Belimo Aircontrols, Inc.
   2. Schneider Electric. Model: DuraDrive Series.
   3. Siemens Industry, Inc.

B. Operation: Two-position or reversing type proportional motor, as determined by location and application.

C. Enclosure Rating: NEMA 250 Type 1 Enclosure.

D. Mounting: Direct mount.

E. Stroke: Maximum 150 seconds end to end full stroke, Maximum 20 seconds return to normal for spring return.

F. Protection: Electronic stall protection.

G. Control Input: 0-10 VDC or 0-20 mADC.

H. Power: Nominal 24 or 120 volt AC.

I. Torque: Size for minimum 150 percent of required duty.

J. Duty cycle: rated for 65,000 cycles.

K. Accessories:
   1. Cover mounted transformer.
   2. Auxiliary potentiometer.
   3. Damper linkage.
   4. Direct drive feedback potentiometer.
   5. Output position feedback.
   6. Field selectable rotational, spring return direction, field adjustable zero and span.
   7. End switch.

2.11 TRANSFORMERS

A. Manufacturers:
   1. Square D (Schneider Electric).
   2. Veris Industries.
   3. MAMAC Systems, Inc.
   4. Honeywell International, Inc.

B. Provide adequate low voltage transformer power to all DDC controllers. Transformers shall not be loaded greater than 75% of rated VA capacity.

C. Transformer locations and equipment served by transformer must be noted and documented on drawings and final as-builts.

D. Transformers shall be equipped with circuit protection for the low voltage circuit.

2.12 FREEZE STAT

A. Manufacturers:
   1. Automatic Components, Inc. (ACI).
   2. MAMAC Systems, Inc.
   3. Johnson Controls, Inc.
   4. Schneider Electric.
   5. Honeywell International, Inc.

B. Freeze protection thermostat: Automatic reset and dual contacts. One set of contacts shall be hardwired to stop fan in the event of a trip. The second set of contacts shall be used to send a signal to the BAS.

C. Trip range shall be adjustable and set for 35 degree F initially.

D. Sensor probe shall be averaging, and shall adequately cover the entire face of the coil.

2.13 AIRFLOW PROVING SWITCH

A. Manufacturers:
   1. McMaster-Carr or equal.

B. Hazardous location rated insertion flow switch for air, water, gas.
   1. 316 Stainless steel body and paddle.
   2. Explosion proof.
   3. NEC Class 1 Division 1 rated.
   4. 120V AC.
   5. Trimmable paddle.

2.14 VARIABLE FREQUENCY DRIVES (VFD)

A. Manufacturers:
   1. Square D (Schneider Electric).
   2. Cutler-Hammer (Eaton).
   3. Allen-Bradley (Rockwell Automation, Inc.).
   4. Danfoss Group Global.
   5. ABB.
   6. Yaskawa America, Inc.
   7. All VFDs provided and installed by Division 26 unless otherwise noted.

B. All makeup air units shall have the VFDs factory mounted in the units with provisions for low ambient conditions and venting as required to ensure proper operation.

C. Furnish complete variable speed drive(s) as specified herein. All standard and optional features requested shall be included within the VFD enclosure unless otherwise specified. Drives shall be for variable torque load, unless otherwise noted.

D. The variable speed drives shall convert three-phase, 60 HZ utility power to adjustable voltage and frequency, three-phase, AC power for step less motor speed control from 10% to 100% of the motor's 60 Hz speed. Input voltage shall be as specified in the schedule.

E. The VFD power input stage shall convert three-phase AC line power to a fixed DC bus voltage. This will be accomplished with a solid state three-phase full-wave diode rectifier with metal oxide varistor (MOV) three-phase protection. Displacement power factor shall not be less than 0.95 throughout the speed range. Input line inductors (3%) shall be included on the line side of the power input state.

F. The VFD output power shall vary frequency to the motor from 6 to 60 Hz with resultant motor speed varying at the motor nameplate rated speed, with output voltage variation from zero to motor rated voltage for optimum volts per hertz (V/Hz) ratio for fan and pump loads. Output current shall be rated 110% of motor full load amps (FLA) for 1 minute based upon VFD's variable torque FLA rating. The output must be a voltage source type generating a sine coded PWM waveform utilizing an asynchronous carrier frequency (output transistor switching frequency is to be independent of drive output frequency). This carrier frequency shall be adjustable to minimize harmonically induced noise or vibration.

G. The VFD shall include the following features:
   1. The VFD shall be housed in a NEMA 1 enclosure.
   2. The following display/control parameters shall be located on the front of the enclosure:
      a. Hand/Off/Auto selector to start and stop the motor. In the auto position, the drive shall start/stop from a remote contact closure. In the auto position, motor speed shall be determined by the follower signal. In the manual position, motor speed shall be determined by a manual adjustment.
      b. Power on indication that the VFD is being supplied by the power line.
      c. Fault indication that the VFD has tripped on a fault condition.
      d. Display shall indicate load parameters such as load percent, frequency or running load amps.
   3. A set of form C, dry contacts to indicate when the VFD is in the run mode.
   4. A set of form C, dry contacts to indicate when the VFD is in the fault mode.
   5. Terminations for safety interlocks such as freeze and smoke shut-down.
   6. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function shall provide up to 6 programmable restart attempts. The time delay before restart attempts shall be a minimum of 30 seconds. This function permits automatic restarting after the drive controller detects a fault, provided that the other operating functions are correct, a run command is present, and the fault has disappeared. This shall be a function that is field selectable.
   7. Speed Reference Input: Shall accept both a manual speed signal and a 0-10 VDC speed reference analog input signal from the Building Automation System (BAS).
   8. Feedback Signal: Provide 0-5 VDC or 0-20 mA analog output signal to indicate actual operating speed of VFD. Output signal shall be fed into the BAS.
   9. Skip Frequencies: Lock-out resonant frequencies of fans or pumps.

H. The VFD shall include the following protective features:
   1. Protection against input transient voltage spikes.
   2. Separate overload protection for each motor controlled.
   3. Protection against input power under voltage, over voltage, and phase loss.
   4. Protection against output current overload and over current.
   5. Protection against over temperature within the VFD enclosure.
   6. Protection against over voltage on the DC bus.
   7. DC bus discharge circuit for protection of service personnel.

8. Insensitive to incoming power phase sequence.

I. The VFD shall include the following adjustments inside the enclosure:
   1. Maximum speed, adjustable 50-100% base speed.
   2. Minimum speed, adjustable 0-50% base speed.
   3. Acceleration time, adjustable 3 to 1800 seconds.
   4. Deceleration time, adjustable 3 to 1800 seconds with override circuit to prevent nuisance trips if decel time is set too short.
   5. Current limit, adjustable 0-100%.

J. The VFD shall be designed to operate within the following service conditions:
   1. Ambient temperature, 0-40 degree C (32 to 104 degree F).
   2. 0 to 95% relative humidity, non-condensing.
   3. Elevation to 1,000 meters (3,300 feet) without derating.
   4. AC line voltage variation, -10% to +10% of nominal.

K. The VFD shall be provided with a complete, wired internal factory mounted disconnect switch.

2.15 CO/NO2 GAS MONITORING SENSORS

A. Manufacturers:
   i. Manufacturers:
      1. Veris
      2. Honeywell
      3. Vulcain
      4. Kele
      5. Approved equal

B. Gas Detection sensor modules with analog 4-20ma or 0-10VDC outputs. Sensors shall be mounted at 5 ft above finished floor. CO Sensor modules will have status LEDs for low, high and power/fail indication.

C. Override timer: Provisions shall be made to include an intermatic spring wound 30 minute timer to allow the user to override the gas detection sensor to activate the ventilation system.

D. Sensor shall detect the following gases:
   a. CO Carbon Monoxide
   b. NO_2 Nitrogen Dioxide

E. Accuracy: Plus or minus 3% at full scale.
F. Alarm: 85 dB at 10ft.
G. Detection Ranges and alarm levels:

Detection Ranges and Alarm Levels					
Gas	**Resolution**	**Range**	**Alarm A**	**Alarm B**	**Alarm C**
CO (Carbon monoxide)	1 ppm	0-250 ppm	25 ppm	100 ppm	225 ppm
H_2S (Hydrogen sulfide)	0.1 ppm	0-50 ppm	10 ppm	15 ppm	20 ppm
NO_2 (Nitrogen dioxide)	0.1 ppm	0-10 ppm	0.7 ppm	2 ppm	9 ppm
O_2 (Oxygen)	0.1% vol.	0-25% vol.	19.5% vol.	22% vol.	22.5% vol.
H_2 (Hydrogen)	0.5% LEL	0-100% LEL	25% LEL	50% LEL	90% LEL
CH_4 (Methane)	0.5% LEL	0-100% LEL	25% LEL	50% LEL	90% LEL
C_3H_8 (Propane)	0.5% LEL	0-100% LEL	25% LEL	50% LEL	90% LEL

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify building systems to be controlled are ready to operate.

B. Verify that conditioned power supply is available to control units.

C. Verify air handling units and ductwork have been accepted and air filters are in place before installing sensors in air streams.

D. Verify location of thermostats and other exposed control sensors with Drawings before installation.

3.2 INSTALLATION

A. Install equipment level and plumb.

B. Install thermostats, space temperature sensors, and other exposed control sensors after locations are coordinated with other Work.

C. Install thermostats, space temperature sensors, and other exposed control sensors 60 inches (or 48 inches above floor when required for ADA compliance). Align with light switches.

D. Install freeze protection thermostats using flanges and element holders.

E. Install carbon monoxide (CO) alarms in all new and existing rooms containing a fuel-burning appliance per 2020 Minnesota Mechanical and Fuel Gas Code. CO alarms shall be UL 2034 listed.

F. Provide separable sockets for liquids and flanges for air bulb elements.

G. Install thermostats as indicated on Drawings.

H. Install guards on thermostats in public areas, entrances, gymnasiums, and as indicated on Drawings.

I. Install control panels adjacent to associated equipment on vibration free walls or freestanding supports. Use one cabinet for each system. Install engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

J. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

K. Install conduit and electrical wiring in accordance with Division 26.

L. Control wiring shall be installed in EMT conduit in inaccessible locations such as walls and floors and where exposed on walls.

M. Install labels and nameplates to identify control components. Refer to Section 23 05 53. Label as indicated on Drawings and coordinate all labels with the Mechanical Contractor, Plumbing Contractor, and Electrical Contractor.

3.3 FIELD QUALITY CONTROL

A. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

3.4 DEMONSTRATION AND TRAINING

A. Demonstrate complete operation of systems, including Sequence of Operation prior to Date of Substantial Completion.

B. Demonstrate complete and operating system to Owner. Refer to Section 23 09 93.

END OF SECTION

SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section includes sequence of operation for:
   1. General:
      a. Zone Sensors
      b. Building Sensors
   2. Primary Air Systems:
      a. Grade Mounted Make-Up Air Handling Units (MAU)
      b. Furnaces and Condensing Units
   3. Terminal Air Systems:
      a. Exhaust Fans
      b. Electric Unit Heaters
      c. Electric Wall Heaters
      d. Electric Baseboard Heaters
      e. Gas-Fired Unit Heaters
   4. Miscellaneous Systems:
      a. Domestic Hot Water
      b. Split Systems

B. Related Sections:
   1. Section 23 09 00 - Instrumentation and Control for HVAC: For equipment, devices, and system components to implement sequences of operation.

1.2 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.3 DEFINITIONS

A. DAT – Discharge Air Temperature

B. EA – Exhaust Air

C. EAT – Entering Air Temperature

D. EWT – Entering Water Temperature

E. HCV – Heating Coil Valve.

F. LAT – Leaving Air Temperature

G. LWT – Leaving Water Temperature

H. OA – Outdoor Air

I. OAF – Outdoor Air Flow

J. OAT – Outdoor Air Temperature

K. RA – Return Air

L. SWT – Supply Water Temperature

M. ZAT – Zone Air Temperature

1.4 SUBMITTALS

A. Shop Drawings: Indicate mechanical system controlled and control system components.

1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.
2. Submit flow diagrams for each control system, graphically depicting control logic.
3. Coordinate submittals with information requested in Section 23 09 00.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and setpoint of controls, including changes to sequences made after submission of shop drawings.

PART 2 -- PRODUCTS - NOT USED

PART 3 -- EXECUTION

3.1 GENERAL

A. ALARMS, SETPOINTS, AND TIMERS
1. All Setpoints, Timers and Alarms listed in this Section shall be adjustable by Owner.

3.2 PRIMARY AIR SYSTEMS

A. FURNACES AND SPLIT DX CONDENSING UNITS

1. Provide 7-day programmable thermostat with fan/off/auto switch and unoccupied/occupied settings. The space thermostat shall cycle the burner or condensing unit to maintain setpoint. The fan shall run continuously during occupied periods.

3.3 MAKE-UP AIR UNIT (MAU-1) / EXHAUST FAN (EF-2) CONTROL

A. GENERAL

1. Provide complete control sequence for MAU-1, integrated with SCADA and combustible gas detection system by Division 26, in accordance with NFPA 820 requirements for ventilation and explosion hazard mitigation.
2. System shall always maintain the building at a negative pressure relative to outdoors.
3. MAU-1 Integral VFDs:
   a. Factory mounted supply fan VFD controls make-up air unit's two-speed operation.
   b. Factory mounted exhaust fan VFD controls remote EF-2's variable speed operation.

B. NORMAL OPERATION (HIGH-SPEED MODE)

1. MAU-1 supply fan shall operate continuously at high speed to provide at least 12 air changes per hour (ACH), reducing the hazardous area classification from Class I, Division 1 to Class I, Division 2 in accordance with NFPA 820.
2. Exhaust Fan (EF-2) shall be enabled prior to MAU-1 operation and shall be proven ON before MAU-1 is enabled.
3. MAU-1 shall be interlocked with EF-2 such that loss of EF-2 status immediately disables MAU-1.
4. Exhaust fan VFD shall modulate to maintain building pressure setpoint of -0.05 in. w.c. (adj.), maximum -0.10 in. w.c. (adj.).

C. HEATING CONTROL

1. Heating shall be enabled when outdoor air temperature is below 50°F (adj.).
2. MAU-1 shall maintain a minimum discharge air temperature of 60°F (adj.).
3. The space shall be maintained at 60°F (adj.). Discharge air temperature control shall be overridden upon call for heating from wired room temperature thermostat.

D. REDUCED VENTILATION (LOW-SPEED MODE)

1. MAU-1 may operate at reduced airflow (min. 6 ACH) when all of the following conditions are met:
    a. Outdoor air temperature below 50°F.
    b. Space is unoccupied.
    c. Combustible gas concentration is less than 10% of LFL.
    d. Building pressure remains negative.
2. During low-speed operation:
    a. MAU-1 supply fan VFD shall operate at low speed to provide at least 6 ACH.
    b. EF-2 VFD shall modulate to maintain minimum airflow and building pressure.

E. AUTOMATIC OVERRIDES (SAFETY PRIORITY)

1. System shall automatically revert to high-speed operation upon any of the following:
    a. Combustible gas concentration ≥ 10% LFL.
    b. Space becomes occupied.
    c. Loss of negative building pressure.
    d. Operator override from SCADA.

F. AIRFLOW PROVING AND MONITORING

1. Provide airflow proving device for MAU-1.
2. Provide status monitoring for MAU-1 and EF-2 fan operation.

G. ALARMS

1. Provide common alarm to SCADA for:
    a. MAU-1 commanded ON and fan status OFF.
    b. EF-2 commanded ON and fan status OFF.
    c. Loss of airflow.
    d. Building pressure out of range.

3.4 MAKE-UP AIR UNIT (MAU-2) / EXHAUST FAN (EF-8) CONTROL

A. GENERAL

1. Provide complete control sequence for MAU-2, integrated with SCADA and combustible gas detection system by Division 26, in accordance with NFPA 820 requirements for ventilation and explosion hazard mitigation.
2. System shall always maintain the building at a negative pressure relative to outdoors.
3. MAU-2 Integral VFDs:
    a. Factory mounted supply fan VFD controls make-up air unit's two-speed operation.
    b. Factory mounted exhaust fan VFD controls remote EF-8's variable speed operation.

B. NORMAL OPERATION (HIGH-SPEED MODE)

1. MAU-2 supply fan shall operate continuously at high speed to provide at least 12 air changes per hour (ACH), reducing the hazardous area classification from Class I, Division 1 to Class I, Division 2 in accordance with NFPA 820.
2. Exhaust Fan (EF-8) shall be enabled prior to MAU-2 operation and shall be proven ON before MAU-1 is enabled.
3. MAU-1 shall be interlocked with EF-8 such that loss of EF-8 status immediately disables MAU-2.
4. Exhaust fan VFD shall modulate to maintain building pressure setpoint of -0.05 in. w.c. (adj.), maximum -0.10 in. w.c. (adj.).

C. HEATING CONTROL

1. Heating shall be enabled when outdoor air temperature is below 50°F (adj.).
2. MAU-2 shall maintain a minimum discharge air temperature of 50°F (adj.).

3. The space shall be maintained at 50°F (adj.). Discharge air temperature control shall be overridden upon call for heating from wired room temperature thermostat.

D. REDUCED VENTILATION (LOW-SPEED MODE)
1. MAU-2 may operate at reduced airflow (min. 6 ACH) when all of the following conditions are met:
   a. Outdoor air temperature below 50°F.
   b. Space is unoccupied.
   c. Combustible gas concentration is less than 10% of LFL.
   d. Building pressure remains negative.
2. During low-speed operation:
   a. MAU-2 supply fan VFD shall operate at low speed to provide at least 6 ACH.
   b. EF-8 VFD shall modulate to maintain minimum airflow and building pressure.

E. AUTOMATIC OVERRIDES (SAFETY PRIORITY)
1. System shall automatically revert to high-speed operation upon any of the following:
   a. Combustible gas concentration ≥ 10% LFL.
   b. Space becomes occupied.
   c. Loss of negative building pressure.
   d. Operator override from SCADA.

F. AIRFLOW PROVING AND MONITORING

1. Provide airflow proving device for MAU-2.
2. Provide status monitoring for MAU-2 and EF-8 fan operation.

G. ALARMS

1. Provide common alarm to SCADA for:
   a. MAU-2 commanded ON and fan status OFF.
   b. EF-8 commanded ON and fan status OFF.
   c. Loss of airflow.
   d. Building pressure out of range.

3.5 TERMINAL AIR SYSTEMS

A. DISINFECTION BUILDING, BLOWER ROOM (EF-5)
1. Exhaust fan shall be provided with manual speed control for balancing purposes. Exhaust fan shall operate on a reverse-acting thermostat as needed to maintain the space temperature below 95°F (adj.). Coordinate with the electrical contractor.
2. Exhaust fan shall operate in unison with damper and intake louver damper. Fan shall energize and motorized dampers shall open when thermostat call is on. Fan shall de-energize and dampers shall close when thermostat call is off.

B. BATHROOM EXHAUST FAN (EF-11,12)
1. Exhaust fan shall be interlocked with light switch in associated bathroom.
   a. Fan is energized when the space is occupied / light switch is on.
   b. Fan is de-energized when the space is unoccupied / light switch is off.

C. CHEMICAL ROOM EXHAUST FAN (EF-3,7)
1. Exhaust fan shall be provided with manual speed control for balancing purposes. Fan shall be interlocked with light switch for manual operation whenever room is occupied.
2. Exhaust fan shall operate in unison with motorized dampers located at associated outdoor air louver.
   a. Fan is energized and motorized dampers at louver and EF-X open when the space is occupied / light switch is on.
   b. Fan is de-energized and motorized dampers at Louver and EF-X close when the space is unoccupied / light switch is off.

D. CHLORINE/SULFUR DIOXIDE ROOM EXHAUST FAN (EF-4,6)
   1. Exhaust fan shall be provided with manual speed control for balancing purposes. Fan shall be interlocked with light switch for manual operation whenever space is occupied.
   2. Exhaust fan EF-5 shall operate in unison with motorized dampers at exhaust fan and intake louver.
      a. Fan starts and motorized damper at louver opens when light switch is on.
      b. Fan stops and motorized damper at louver closes when light switch is off.
      c. Fan and motorized dampers shall also operate ON or OFF via door contact and manual wall switches for respective room the space serves. Refer to Division 26 for more information.

E. GARAGE – EXHAUST FAN CONTROL (EF-1):
   1. Exhaust fan shall be provided with manual speed control for balancing purposes.
   2. Refer to Division 26 specifications and control schematics for further information.
   3. OPERATION:
      a. Exhaust fan shall be interlocked and operate in unison with motorized dampers located at outdoor air intake louver (L-1) serving room.
      b. Fan shall run in automatic operation based on the level from the gas-detection sensor monitored by SCADA. Initial carbon monoxide gas detector alarm level of 35 PPM per code.

F. CLARIFIERS - EXHAUST FAN CONTROL (EF-9,10):
   1. Exhaust fan shall be provided with manual speed control for balancing purposes.
   2. Fan shall be interlocked with light switch for manual operation whenever room is occupied.

G. GAS-FIRED UNIT HEATERS (GUH)
   1. Gas-fired unit heater (GUH-*) shall be controlled with a single wall-mounted, line voltage thermostat.
   2. As space temperature falls below the heating set point (adj.), the thermostat shall maintain the zone air temperature (ZAT) setpoint by enabling the heater.
   3. ZAT setpoint shall be 65°F (adj.).

A. ELECTRIC UNIT HEATER (EUH)
   1. Electric unit heater (EUH-*) shall be controlled with a single wall-mounted, line voltage thermostat.
   2. As space temperature falls below the heating set point (adj.), the thermostat shall maintain the zone air temperature (ZAT) setpoint by enabling the heater and cycling the fan on/off. ZAT setpoint shall be 65°F (adj.).

B. ELECTRIC WALL HEATER (FFH)
   1. Fan Forced Heater (FF-*) shall be controlled with integral thermostat.
   2. As space temperature falls below the heating set point (adj.), the thermostat shall maintain the zone air temperature (ZAT) setpoint by enabling the heater and cycling the fan on/off. ZAT setpoint shall be 68°F (adj.).
   3. For heaters located in vestibules, provide controls to limit thermostat setpoint to 68F, and controls capable of disabling unit when outdoor air temperatures are above 60F.

C. BASEBOARD HEATER (BB):
   1. Electric unit heater (BB-*) shall be controlled with a single integral thermostat, with tamper resistant cover as a backup heating source.
   2. As space temperature falls below the heating set point (adj.), the thermostat shall maintain the zone air temperature (ZAT) setpoint by enabling the heater and cycling the fan on/off. ZAT setpoint shall be 65°F (adj.).

D. SPLIT SYSTEM INDOOR UNITS (MSI) AND OUTDOOR UNITS (MSO):

1. Split system indoor unit (MSI-*) shall be controlled with a single wall-mounted thermostat and shall control operation of both indoor and outdoor systems.
2. As space temperature falls below the cooling set point (adj.), the thermostat shall maintain the zone air temperature (ZAT) setpoint by enabling the evaporator fan and outdoor compressor, cycling the fan on/off. ZAT setpoint shall be 75°F (adj.).

3.6 MISCELLANEOUS SYSTEMS

A. DOMESTIC HOT WATER
   1. HOT WATER RECIRCULATION PUMP (HWCP-1):
      a. TIME SCHEDULE:
         1) All Recirculation Pumps shall utilize a Time Schedule.
      b. OPERATION:
         1) Recirculation Pumps is ON when
            a) Time Schedule is ON.
         2) Recirculation Pumps is OFF when
            a) Time Schedule is OFF.

END OF SECTION

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Natural gas piping buried within 5 feet of building.
2. Natural gas piping above grade.
3. Unions and flanges.
4. Valves.
5. Pipe hangers and supports.
6. Strainers.
7. Natural gas pressure regulators.
8. Natural gas pressure relief valves.
9. Underground pipe markers.
10. Bedding and cover materials.

B. Related Sections:
1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports [and firestopping] for placement by this section.
2. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for valve and pipe identification for placement by this section.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

B. American Society of Mechanical Engineers:
1. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
3. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 175 psi (Sizes NPS 1/2 through NPS 2).
4. ASME B31.1 – Power Piping.
5. ASME B31.9 - Building Services Piping.
6. ASME BPVC Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. ASTM International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
6. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
7. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Welding Society:
1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

E. American Water Works Association:
1. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacturer, Selection, Application, and Installation.
   2. MSS SP-67 - Butterfly Valves.
   3. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
   4. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

G. Minnesota Department of Labor & Industry:
   1. Minnesota Mechanical and Fuel Gas Code.

H. National Fire Protection Association:
   1. NFPA 54 - National Fuel Gas Code.

I. Underwriters Laboratories Inc.:
   1. UL 842 - Standard for Valves for Flammable Fluids.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

B. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

C. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.

D. Provide pipe hangers and supports in accordance with MSS SP-58.

E. Use ball valves or plug valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
   3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
      a. Strainers.
      b. Natural gas pressure regulators.
      c. Natural gas pressure relief valves.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, piping system, and system components.

B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions and spare parts lists.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Perform natural gas Work in accordance with NFPA 54.

C. Perform work in accordance with local gas company requirements.

D. Perform Work in accordance with ASME B31.1 and ASME B31.9 code for installation of piping systems and ASME Section BPVC IX for welding materials and procedures.

E. Perform Work in accordance with AWS D1.1/D1.1M for welding hanger and support attachments to building structure.

F. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 COORDINATION

A. Coordinate trenching, excavating, bedding, and backfilling of buried piping systems with Construction Manager.

PART 2 -- PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 galvanized.
   1. Fittings: ASTM A234/A234M forged steel welding type, galvanized.
   2. Joints: ASME B31.9, welded.
   3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

B. Polyethylene Pipe (PE): ASTM D2513
   1. Labeling: Marked “Gas” and “ASTM D2513”
   2. Fittings: Polyethylene, ASTM D2513.
   3. Joints: Compression-type mechanical joints with internal tubular rigid stiffener.

C. Copper Tubing: ASTM B88, Type K or L, annealed.
   1. Fittings: ASME B16.26 cast bronze.
   2. Joints: Brazed.

2.2 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
   2. Joints:
      a. Pipe 2 inches and smaller: Threaded.
      b. Pipe 2-1/2 inches and larger: Welded.
   3. Outdoor and High-Humidity Applications: Pipe and fittings to be galvanized.

B. Copper Tubing: ASTM B88, Type K or L, annealed.
   1. Fittings: ASME B16.26 cast bronze.
      a. Option: Compression type.

2. Joints: Brazed.
    a. Option: Flared (compression type).

2.3 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
    1. Ferrous Piping: Class 150, malleable iron, threaded.
    2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:
    1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
    2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.4 BALL VALVES

A. Manufacturers:
    1. Crane Valve, North America.
    2. Hammond Valve.
    3. Milwaukee Valve Company.
    4. NIBCO, Inc.
    5. Stockham Valves & Fittings.

B. 1/4 inch to 1 inch: MSS SP-110, Class 125, two-piece, threaded ends, bronze body, chrome plated bronze ball, reinforced Teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.

2.5 PLUG VALVES

A. Manufacturers:
    1. DeZURIK, Unit of SPX Corp.
    2. Flow Control Equipment, Inc.
    3. Homestead Valve.

B. 2-1/2 inches and Larger: MSS SP-78, Class 150, round port, full pipe area, pressure lubricated, Teflon packing, flanged ends.

2.6 PIPE HANGERS AND SUPPORTS

A. Refer to Section 23 05 29.

2.7 STRAINERS

A. Manufacturers:
    1. Mueller Steam Specialty.
    2. O.C. Keckley Company.
    3. Spirax Sarco, Inc.

B. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.8 NATURAL GAS PRESSURE REGULATORS

A. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
    1. Temperatures: minus 20 degrees F to 150 degrees F.
    2. Body: Cast iron.

3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
4. Disk, diaphragm, and O-ring: Nitrile.
5. Maximum inlet pressure: 150 psig.
6. Furnish sizes 2 inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

PART 3 -- EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install pipe hangers and supports in accordance with Section 23 05 29.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. All pipe sizing on Drawings is using steel pipe. Pipe sizing to be verify by Contractor if non-steel pipe is used.

B. Install natural gas piping in accordance with NFPA 54.

C. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.

D. Establish elevations of buried piping with not less than 2 ft of cover.

E. Establish minimum separation from other service piping in accordance with Minnesota Mechanical and Fuel Gas Code.

F. Remove scale and dirt on inside of piping before assembly.

G. Excavate pipe trench in accordance with Division 31.

H. Install pipe to elevation as indicated on Drawings.

I. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth; compact to 95 percent maximum density.

J. Install pipe on prepared bedding.

K. Route pipe in straight line.

L. Install pipe to allow for expansion and contraction without stressing pipe or joints.

M. Install trace wire continuous over top of pipe, buried 6 inches below finish grade.

N. Pipe Cover and Backfilling:
1. Backfill trench in accordance with Division 31.
2. Maintain optimum moisture content of fill material to attain required compaction density.
3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
5. Do not use wheeled or tracked vehicles for tamping.

3.4 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. All pipe sizing on Drawings is using steel pipe. Pipe sizing to be verify by Contractor if non-steel pipe is used.

B. Install natural gas piping in accordance with NFPA 54.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
   1. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
   2. For large holes in wall, floor, and ceiling assemblies: Infill, patch, and seal the annular space around pipe penetration. Match materials and finishes of adjacent work.

H. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Division 07.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access where valves and fittings are not exposed.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.

L. Provide support for utility meters in accordance with requirements of utility company.

M. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood. Do not install within 10 feet of fresh air intakes.

N. Install valves with stems upright or horizontal, not inverted.

O. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

P. Install gas pressure regulator with independent vent full size opening on regulator and terminate outdoors.

3.5 FIELD QUALITY CONTROL

A. Inspect, test and purge gas piping in accordance with Minnesota Mechanical and Fuel Gas Code and local gas utility company requirements.

B. When pressure tests do not meet specified requirements, remove defective work, replace, and retest.

END OF SECTION

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Refrigerant piping.
2. Unions, flanges, and couplings.
3. Pipe hangers and supports.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant filter-driers.
7. Refrigerant solenoid valves.

B. Related Sections:
1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports, sleeves, for placement by this section.
2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
3. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
4. Section 23 07 00 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.

1.2 REFERENCES

A. Air-Conditioning, Heating, & Refrigeration Institute:
1. AHRI 710 - Performance Rating of Liquid-Line Driers.
2. AHRI 760 - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 15 - Safety Standard for Refrigeration Systems.

C. American Society of Mechanical Engineers:
1. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
2. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.

D. ASTM International:
1. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

E. American Welding Society:
1. AWS A5.8 - Filler Metals for Brazing & Braze Welding.
2. AWS D1.1/D1.1M - Structural Welding Code - Steel.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

B. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

C. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.

D. Provide pipe hangers and supports in accordance with ASME B31.5.

E. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

1.4 SUBMITTALS

A. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.

B. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
   3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
   4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
      a. Refrigerant moisture and liquid indicators.
      b. Refrigerant filter-driers.
      c. Refrigerant solenoid valves.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.

D. Welders' Certificate: Include welders' certification of compliance with ASME BPVC Section IX, AWS D1.1/D1.1M, or equivalent.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, equipment, and refrigerant accessories.

B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Perform Work in accordance with ASME B31.5 code for installation of refrigerant piping systems.

C. Perform Work in accordance with AWS D1.1/D1.1M for welding hanger and support attachments to building structure.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 COORDINATION

A. Coordinate trenching, excavating, bedding, and backfilling of buried piping systems with Construction Manager.

PART 2 -- PRODUCTS

2.1 REFRIGERANT PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn.
   1. Fittings: ASME B16.22 wrought copper.
   2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.2 UNIONS, FLANGES, AND COUPLINGS

A. 2 inches and Smaller:
   1. Copper Pipe: Bronze, soldered joints.

B. 2-1/2 inches and Larger:
   1. Copper Piping: Bronze.

2.3 PIPE HANGERS AND SUPPORTS

A. Refer to Section 23 05 29.

B. Conform to ASME B31.5.

2.4 REFRIGERANT MOISTURE AND LIQUID INDICATORS

A. Manufacturers:
   1. Alco Controls Div, Emerson Electric Co.
   2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
   3. Sporlan Valve Co.

B. Indicators:
   1. Port: Single, UL listed.
   2. Body: Copper or brass, flared or solder ends.
   3. Sight glass: Color-coded paper moisture indicator and plastic cap.
   4. Maximum working pressure: 500 psig
   5. Maximum working temperature: 200 degrees F.

2.5 VALVES

A. Manufacturers:
   1. Alco Controls Div, Emerson Electric Co.
   2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
   3. Sporlan Valve Co.

B. Diaphragm Packless Valves:
   1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
   2. Phosphor bronze and stainless steel diaphragms, rising stem and hand wheel.
   3. Stainless steel spring, nylon seats, disc with positive back seating.
   4. Maximum working pressure: 500 psig.
   5. Maximum working temperature: 275 degrees F.

C. Packed Angle Valves:
   1. Forged brass or nickel-plated forged steel, solder or flared ends.

2. Forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing.
3. Maximum working pressure: 500 psig.
4. Maximum working temperature: 275 degrees F.

D. Ball Valves:
1. Two piece forged brass body with teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
2. Maximum working pressure: 500 psig.
3. Maximum working temperature: 325 degrees F.

E. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends.
2. Maximum working pressure: 500 psig.

F. Refrigerant Check Valves:
1. Manufacturers:
a. Alco Controls Div, Emerson Electric Co.
b. Parker Hannifin Corp., Refrig. & Air Cond. Div.
c. Sporlan Valve Co.
2. Straight Through Type:
a. Spring, neoprene seat.
b. Maximum working pressure: 500 psig.
c. Maximum working temperature: 250 degrees F.

2.6 REFRIGERANT FILTER-DRIERS

A. Manufacturers:
1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Permanent Straight Through Type:
1. AHRI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.

2.7 REFRIGERANT SOLENOID VALVES

A. Manufacturers:
1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Valve: AHRI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psig. Stem designed to allow manual operation in case of coil failure.

C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color-coded lead wires, integral junction box.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install pipe hangers and supports in accordance with ASME B31.5 and Section 23 05 29.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Route piping parallel to building structure and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.

E. Install pipe identification in accordance with Section 23 05 53.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

H. Flood refrigerant piping system with nitrogen when brazing.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds. Install valves with stems upright or horizontal, not inverted.

J. Insulate piping and equipment; refer to Section 23 07 00.

K. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

L. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

M. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

N. Fully charge completed system with refrigerant after testing.

O. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

P. Install refrigerant piping in accordance with ASME B31.5.

3.6 INSTALLATION - REFRIGERANT SPECIALTIES

A. Refrigerant Liquid Indicators:
   1. Install line size liquid indicators in main liquid line downstream of condenser.
   2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
   3. Install line size liquid indicators downstream of liquid solenoid valves.

B. Refrigerant Valves:

1. Install service valves on compressor suction and discharge.
2. Install gage taps at compressor inlet and outlet.
3. Install gage taps at hot gas bypass regulators, inlet and outlet.
4. Install check valves on condenser liquid lines on multiple condenser systems.
5. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.

C. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

D. Filter-Dryers:
1. Install permanent filter-dryers in liquid lines.

E. Solenoid Valves:
1. Install in liquid line of each system.
2. Install in liquid line of single or multiple evaporator systems.

F. Refrigerant Circuit Access Ports:
1. Refrigerant circuit access ports located outdoors shall be fitted with locking-type tamper-resistant caps or shall be otherwise secured to prevent unauthorized access.
a. Exception: Not applicable to refrigerant access ports or equipment installed in controlled areas such as on roofs with locked access hatches or doors.

3.7 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

B. Pressure test refrigeration system with dry nitrogen to 200 psig.

C. Repair leaks.

D. Retest until no leaks are detected.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Duct Materials.
2. Insulated flexible ducts.
3. Single wall longitudinal-seam round ducts.
4. Single wall spiral-seam round ducts.
5. Transverse duct connection system.
6. Ductwork fabrication.
7. Outdoor pre-insulated duct systems.

B. Related Sections:
1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

C. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - HVAC Air Duct Leakage Test Manual.
2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

D. Underwriters Laboratories Inc.:
1. UL 181 - Standard for Factory-Made Air Ducts and Connectors.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.5 SUBMITTALS

A. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.7 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

C. Construct ductwork to NFPA 90A (as well as NFPA 90B and NFPA 96 as applicable) standards.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 DUCT MATERIALS

A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90/A90M.

B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength. All aluminum ductwork shall be two gauges heavier than as indicated in SMACNA Standard.

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded. Provide aluminum/stainless hangers and duct supports where aluminum/stainless ductwork is specified.

E. Finish: Paintable for exposed, uninsulated duct.

2.2 INSULATED FLEXIBLE DUCTS

A. Product Description: Two ply vinyl film supported by helical wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
   1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
   2. Maximum Velocity: 4000 fpm.
   3. Temperature Range: -10 degrees F to 160 degrees F.
   4. Thermal Resistance: 4.2 square feet-hour-degree F per BTU.

2.3 SINGLE WALL LONGITUDINAL-SEAM ROUND DUCTS

A. Product Description: UL 181, Class 1, round longitudinal snaplock seam duct constructed of galvanized steel.

B. Longitudinal seam ducts are only allowed for 14-inch or smaller diameter ducts for 2-inch or less duct pressure classifications.

2.4 SINGLE WALL SPIRAL ROUND DUCTS

A. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.

B. This type of duct is also available in type 304 or 316 stainless steel and aluminum. Modify gauges to suit project conditions where applicable.

C. Construct duct with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	26
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

D. Construct fittings with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20
52 inches to 60 inches	18
62 inches to 84 inches	16

2.5 TRANSVERSE DUCT CONNECTION SYSTEM

A. Product Description: SMACNA "J" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

B. Spiral Duct Product Description: 16-gauge flange system with barrel clamp and bolt lock systems and neoprene gasket.

2.6 DUCTWORK FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

2.7 OUTDOOR PRE-INSULATED DUCT SYSTEMS

A. Manufacturers:
1. AQC Industries, LLC., Model: Q Duct.
2. Thermaduct (fortified Kingspan KoolDuct).
3. Pro-R.

B. Description: Prefabricated outdoor ductwork system that is insulated with weatherproofing and vapor barrier.

C. Construction:
1. Insulation: Rigid phenolic or closed cell foam.
a. R-Value: Minimum R-12.
2. Weather Barrier: Vinyl cladding. Shall be impact, tear, and puncture resistant, water-tight, UV stable,
3. Vapor Barrier: Zero permeability.
4. Air Sealing: Low air leakage.

D. Performance:
1. Conforms to ASTM E 85 or UL 723 flame spread and smoke development criteria.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION - GENERAL

A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.

D. Install duct hangers and supports in accordance with Section 23 05 29.

E. Use double nuts and lock washers on threaded rod supports.

F. Connect flexible ducts to metal ducts with draw bands and adhesive.

G. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.

H. All takeoffs shall be pre-manufactured high efficiency with integral volume damper and neoprene gasket flange seal.

I. Seam and joint sealing:

1. Seam duct seams and joints according to SMACNA - HVAC Duct Construction Standards - Metal and Flexible for duct pressure class indicated.
2. Seal all transverse joints, longitudinal joints, and duct penetrations.
3. Seal to achieve no visible or audible leaks.
4. Seal externally insulated ducts before insulation is applied.
5. Seal exposed joints internally during installation. Do not use external sealant on exposed ducts
6. Outside air and exhaust/relief air ducts shall be sealed water-tight and sloped to drain.
7. Ducts shall be sealed to meet MN Rules 1346.0603. Pressure sensitive tape shall NOT be used as the primary sealant.

J. Where ductwork penetrates floor, ceiling, or wall, close off space between duct and adjacent work with insulation and caulk airtight. Provide close fitting metal collar at both sides of penetration.
   1. For large holes in wall, floor, and ceiling assemblies: Infill, patch, and seal the annular space around duct penetration. Match materials and finishes of adjacent work.

K. Install firestopping at fire rated construction perimeters and openings containing penetrating ductwork. Refer to Section 23 05 29 and Division 07.

3.3 INSTALLATION – OUTDOOR PRE-INSULATED DUCT SYSTEM

A. Install per Manufacturer's instructions.

B. Ductwork shall be fastened to roof to resist uplift forces in high-wind events.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

B. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

C. Connect air terminal units, air outlets, and air inlets to supply ducts directly or with five foot maximum length of flexible duct. Do not use flexible duct to change direction.

3.5 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.6 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Outdoor Mounted (Make-up Air)	Pre-Insulated Ductwork System
Supply	Galvanized Steel or Aluminum
Return and Relief	Galvanized Steel or Aluminum
General Exhaust	Galvanized Steel or Aluminum
Supply & Return, 1st 25 FT from RTU (>2000 CFM)	Double-Wall Perforated
Outside Air Intake	Galvanized Steel or Aluminum.

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Supply	Refer to Drawings for system external static pressure. Pressure class to not be less that equipment external static pressure.
Return and Relief	1 inch wg regardless of velocity.
General Exhaust	1 inch wg regardless of velocity.

END OF SECTION

SECTION 23 31 01 - HVAC DUCTS CLEANING

PART 1 -- SPECIAL PROVISIONS

1.1 QUALIFICATION OF THE HVAC SYSTEM CLEANING CONTRACTOR

A. Experience: Documented 5 years experience which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

B. Equipment, Material and Labor: The HVAC system cleaning contractor possess and furnish all necessary equipment, materials and labor to adequately perform the specified services. Sub-contracting is not permitted.

1. Contractor shall assure that its employees have received safety equipment training, ladders and scaffolds training, confined space training and power elevated work platform training, material handling/back care site safety, safety legislation, personal protective equipment, and manufacturers product and material safety data sheets (MSDS) as required for the work.
2. Contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements. Contractor shall submit all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.
3. Licensing: Contractor shall comply with all State and local codes, rules, regulations, and licensing requirements.

1.2 STANDARDS

A. NADCA Standards: The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).

1. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.
2. NADCA Standards must be followed with no modifications or deviations being allowed.

PART 2 -- HVAC SYSTEM CLEANING SPECIFICATIONS AND REQUIREMENTS

2.1 SCOPE OF WORK

A. Scope: This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.

B. Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

C. The HVAC system for this project scope includes: All supply, return, exhaust air grilles and diffusers, all supply, return, exhaust, and outdoor ductwork, turning vanes, scrolls, blades, shafts, baffles, dampers, drive assemblies and louvers are all considered part of the HVAC system to be cleaned under this project scope.

D. All existing exhaust fans to be reused shall be included in the scope.

2.2 HVAC SYSTEM COMPONENT INSPECTIONS AND SITE PREPARATIONS

A. HVAC System Component Inspections: Prior to the commencement of any cleaning work, the HVAC system-cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. The cleanliness inspection should include ductwork, shafts etc. and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple fans, a representative sample of the units should be inspected.

B. The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where

contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented. Damaged system components found during the inspection shall be documented and brought to the attention of the owner.

C. Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.

2.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

A. Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that debris is not otherwise dispersed outside the HVAC system during the cleaning process.

B. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.

C. Controlling Odors: Measures shall be employed to control odors and/or mist vapors during the cleaning process.

D. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be visibly clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.

E. Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.

F. Service Openings: Contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.
   1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.
   2. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.
   3. Closures must not significantly hinder, restrict, or alter the airflow within the system.
   4. Insulation shall be neatly trimmed and sealed around the access panel.
   5. Openings must not compromise the structural integrity of the system.
   6. Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.
   7. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to owner in as-built documents.

G. Air distribution devices (registers, grilles & diffusers): Contractor shall remove and clean all air distribution devices; wash with a de-greaser and re-install.

H. Duct Systems: Contractor shall:
   1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
   2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Tests (see NADCA Standards). Use scorpion cleaning system with predator whip in combination with full contact brushes at all times during cleaning process.

2.4 HEALTH AND SAFETY

A. Cleaning of Coils: Access reheat coils from both sides and power wash clean in a method that will render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Cleaning methods shall not cause any appreciable damage, displacement, inhibition of heat transfer, or erosion to the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

B. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.

C. Site cleanliness: Contractor is responsible to maintain a clean work site and return building to original condition prior to work. Coordinate with owner schedule requirements.

D. Disposal of Debris: All Debris removed from the HVAC System shall be disposed of in accordance with applicable state and local requirements.

2.5 MECHANICAL CLEANING METHODOLOGY

A. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is Contractor responsibility to select Source Removal methods that will render the HVAC system visibly clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.

B. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during the cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured. Magnetic gages must be used to achieve 0.20”w.g.
   1. All vacuum devices exhausting air inside the building shall be equipped HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
   2. All vacuum devices exhausting air outside the facility shall be equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.
   3. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

2.6 CLEANLINESS VERIFICATION

A. General: Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system.

B. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present.
   1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. The owner reserves the right to further verify system cleanliness through visual inspection, Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards.
   2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

3. Cleanliness verification shall be performed immediately after mechanical cleaning and before the HVAC system is restored to normal operation.

2.7 PRE-EXISTING SYSTEM DAMAGE

A. Contractor is responsible to report any problems or concerns with pre-existing system damage before commencing work.

2.8 POST-PROJECT REPORT

A. At the conclusion of the project, Contractor shall provide a report to the owner indicating the success of the cleaning project, as verified through visual inspection.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Duct access doors.
2. Volume control dampers.
3. Back-draft dampers.
4. Flexible duct connections.
5. Control air dampers.
6. Duct-mounted smoke detectors.

B. Related Sections:
1. Section 23 09 00 - Instrumentation and Control for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.
2. Section 23 31 00 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:
1. AMCA 500 - Laboratory Methods of Testing Louvers for Rating.

B. ASTM International:
1. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.

C. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
2. NFPA 92A - Recommended Practice for Smoke-Control Systems.

D. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:
1. UL 555 - Standard for Fire Dampers.
2. UL 555C - Standard for Ceiling Dampers.
3. UL 555S - Standard for Smoke Dampers.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 SUBMITTALS

A. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
1. Fire dampers including locations and ratings.
2. Smoke dampers including locations and ratings.

B. Product Data: For fire dampers, smoke dampers, and combination fire and smoke dampers submit the following:
1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
2. Indicate materials, construction, dimensions, and installation details.
3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

C. Manufacturer's Installation Instructions: Submit for fire dampers, ceiling radiation dampers, smoke dampers, and combination fire and smoke dampers.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of access doors and test holes.

B. Operation and Maintenance Data: Submit for fire dampers, ceiling radiation dampers, smoke dampers, and combination fire and smoke dampers.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Dampers tested, rated and labeled in accordance with the latest UL requirements.

C. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

B. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

C. Storage: Store materials in a dry area indoor, protected from damage.

D. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 COORDINATION

A. Coordinate Work where appropriate with building control Work.

1.11 WARRANTY

A. Furnish one year manufacturer warranty for duct accessories.

PART 2 -- PRODUCTS

2.1 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

2.2 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware. Provide non-ferrous dampers in corrosive environments.

C. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.

D. Quadrants:
   1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches furnish regulator at both ends.

2.3 BACK-DRAFT DAMPERS

A. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Provide non-ferrous dampers in corrosive environments. Blades, maximum 6 inch width, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

B. Per 2024 Minnesota Energy Code: Provide back-draft dampers for all exhaust fan systems with airflow less than 300-cfm unless otherwise noted in construction documents.

2.4 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and [as indicated on Drawings.

B. Connector: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
   2. Net Fabric Width: Approximately 6 inches wide.
   3. Metal: 3 inch wide, 24 gage galvanized steel.

2.5 CONTROL AIR DAMPERS - STANDARD

A. Performance: Test in accordance with AMCA 500.

B. Per 2024 Minnesota Energy Code: Provide motorized 2-position or modulating control air dampers for all exhaust fan systems with airflow equal to or greater than 300-cfm.

C. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 16 gage.
   1. Outdoor/Relief Applications: Insulated, thermally-broken frame.

D. Blades: Galvanized steel, maximum blade size 48 inches wide, 48 inches long, minimum 22 gage, attached to minimum 1/2 inch shafts with set screws.

E. Blade Seals: Synthetic elastomeric mechanically attached, field replaceable.

F. Jamb Seals: Stainless steel spring.

G. Shaft Bearings: Graphite impregnated nylon sleeve, with thrust washers at bearings.

H. Linkage Bearings: Graphite impregnated nylon.

I. Air Damper Leakage:
   1. Outside/Relief Damper: Maximum leakage rate of 3.0 cfm per square foot at 1.0 inches wg pressure differential.
   2. General Damper: Less than one percent based on approach velocity of 2000 fpm and 4 inches wg.

J. General Damper Leakage: Maximum leakage rate of 1 percent at 4.0 inches wg pressure differential.

K. Damper Leakage: Less than 1 percent based on approach velocity of 2000 fpm and 4 inches wg.

L. Maximum Pressure Differential: 6 inches wg.

M. Temperature Limits: - 40 to 200 degrees F.

2.6 CONTROL AIR DAMPERS – CORROSION RESISTANT

A. Performance: Test in accordance with AMCA 500.

B. Per 2024 Minnesota Energy Code: Provide motorized 2-position or modulating control air dampers for all exhaust fan systems with airflow equal to or greater than 300-cfm.

C. Frames: All aluminum, welded or riveted with corner reinforcement, minimum 16 gage.

1. Outdoor/Relief Applications: Insulated, thermally-broken frame.

D. Blades: Aluminum, maximum blade size 48 inches wide, 48 inches long, minimum 16 gage, attached to minimum 1/2 inch shafts with set screws.

E. Blade Seals: Synthetic elastomeric mechanically attached, field replaceable.

F. Jamb Seals: Corrosion resistant spring.

G. Shaft Bearings: Corrosion resistant sleeve.

H. Linkage Bearings: Non-ferrous.

I. Air Damper Leakage:

1. Outside/Relief Damper: Maximum leakage rate of 3.0 cfm per square foot at 1.0 inches wg pressure differential.

2. General Damper: Less than 1 percent based on approach velocity of 2000 fpm and 4 inches wg.

J. General Damper Leakage: Maximum leakage rate of 1 percent at 4.0 inches wg pressure differential.

K. Damper Leakage: Less than one percent based on approach velocity of 2000 fpm and 4 inches wg.

L. Maximum Pressure Differential: 6 inches wg.

M. Temperature Limits: - 40 to 200 degrees F.

2.7 DUCT-MOUNTED SMOKE DETECTOR

A. Refer to Drawing Schedules. Refer to Division 28.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify rated walls are ready for fire damper installation.

B. Verify ducts and equipment installation are ready for accessories.

C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION

A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated on Drawings.

C. Access Doors: Install access doors at the following locations and as indicated on Drawings:
   1. Upstream and downstream of each reheat coil.
   2. Before and after each automatic control damper.

D. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access. Review locations prior to fabrication.

3.3 DEMONSTRATION

A. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION

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SECTION 23 34 00 - HVAC FANS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Centrifugal fans.
2. Upblast sidewall fans – Corrosive Environment.
3. Upblast sidewall fans – Standard.
4. Inline fans.

B. Related Sections:
1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for resilient mountings and snubbers for fans for placement by this section.
3. Section 23 07 00 - HVAC Insulation: Product requirements for power ventilators for placement by this section.
4. Section 23 09 00 - Instrumentation and Control for HVAC: Product requirements for control components to interface with fans.
5. Section 23 31 00 - HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
6. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A. American Bearing Manufacturers Association:
1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:
1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. Air-Conditioning, Heating, & Refrigeration Institute:
1. AHRI 1060 - Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.

D. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. Underwriters Laboratories Inc.:
1. UL 705 - Standard for Power Ventilators.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 SUBMITTALS

A. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.

B. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit fan manufacturer’s instructions.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Performance Ratings: Conform to AMCA 210.

C. Sound Ratings: AMCA 301, tested to AMCA 300.

D. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

E. Balance Quality: Conform to AMCA 204.

F. Energy Recovery Unit Energy Transfer Rating: Meet AHRI 1060.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 CENTRIFUGAL FANS

A. Manufacturers:
1. Acme Engineering and Manufacturing Corp.
2. Greenheck Corp.
3. Loren Cook Company.
4. Penn Ventilation.
5. Twin City Fan.
6. Carnes.

B. Wheel and Inlet:
1. Backward Inclined: Steel] construction with smooth curved inlet flange, back plate, backward curved blades welded or riveted to flange and back plate; cast iron hub riveted to back plate and keyed to shaft with set screws.

C. Housing:
1. Steel, spot welded, braced, designed to minimize turbulence with spun inlet bell and shaped cut-off.
2. Factory finish before assembly to manufacturer's standard.

3. Bolted construction with horizontal flanged split housing.
4. Fabricate plug fans without volute housing, in lined steel cabinet.

D. Bearings and Sleeves:
1. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-50 life at 100,000 hours.
2. Shafts: Hot rolled steel, ground and polished, with key way, protectively coated with lubricating oil, and shaft guard.

E. Accessories:
1. Inlet/Outlet Screens: Galvanized steel welded grid.
2. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.
3. Fan speed controller.

F. Motor: Electronically commutated. Refer to Section 23 05 13.
1. Direct drive.

G. Disconnect Switch: Factory wired, non-fusible, in fan housing for thermal overload protected motor, NEMA 250 Type 1 enclosure.

H. Capacity:
1. Refer to Drawings.

I. Electrical Characteristics and Components:
1. Electrical Characteristics: In accordance with Division 26 and the Drawings:

2.2 UPBLAST CENTRIFUGAL SIDEWALL FANS – CORROSIVE ENVIRONMENT

A. Manufacturers:
1. Acme Engineering and Manufacturing Corp.
2. Greenheck Corp.
3. Loren Cook Company.
4. Twin City Fan.
5. Carnes.
6. Penn Ventilation.

B. Fan Unit: Upblast type. direct drive, with spun aluminum housing; resilient mounted motor; aluminum wire bird screen; Hi-Pro polyester coating.

C. Motor: PSC, Spark Resistant type B. Refer to Section 23 05 13.

D. Disconnect Switch: Factory wired, non-fusible, in fan housing for thermal overload protected motor, NEMA 250 Type 1 enclosure.

E. Accessories:
1. Motorized Damper: Electronically actuated, 316 stainless steel multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.
2. Fan speed controller.

F. Performance:
1. Refer to Drawings.

G. Electrical Characteristics and Components:
1. Electrical Characteristics: In accordance with Division 26 and Drawings.

2.3 UPBLAST CENTRIFUGAL SIDEWALL FANS – STANDARD

A. Manufacturers:
1. Acme Engineering and Manufacturing Corp.
2. Greenheck Corp.

3. Loren Cook Company.
4. Twin City Fan.
5. Carnes.
6. Penn Ventilation.

B. Fan Unit: Upblast type. direct drive, with spun aluminum housing; resilient mounted motor; aluminum wire bird screen.

C. Motor: Electronically commutated. Refer to Section 23 05 13.

D. Disconnect Switch: Factory wired, non-fusible, in fan housing for thermal overload protected motor, NEMA 250 Type 1 enclosure.

E. Accessories:
1. Motorized Damper: Electronically actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.
2. Fan speed controller.

F. Performance:
1. Refer to Drawings.

G. Electrical Characteristics and Components:
1. Electrical Characteristics: In accordance with Division 26 and Drawings.

2.4 CENTRIFUGAL INLINE FANS

A. Manufacturers:
1. Acme Engineering and Manufacturing Corp.
2. Greenheck Corp.
3. Loren Cook Company.
4. Penn Ventilation.
5. Twin City Fan

B. Configuration: Inline, horizontal and vertical mount.

C. Centrifugal Fan Unit: Direct driven ECM with aluminum housing lined with 1 inch fiberglass insulation, removable access panels, resilient mounted motor, motorized damper in discharge opening, integral inlet and outlet duct collar; Hi-Pro polyester coating or equal corrosion-resistant coating.

D. Fan mounted toggle switch for thermal overload protected motor.

E. Wheel: Centrifugal backward inclined constructed of aluminum, statically and dynamically balanced.

F. Motor: Open drip proof type with permanently lubricated sealed bearings and thermal overload protection, mounted on rubber-shear isolators.

G. Accessories:
1. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.

2. Motor Operated Damper: Refer to Section 23 33 00.

3. Fan speed controller.

4. Two-speed controller, including a 24VDC transformer that accepts a line voltage input.
a. Motor RPM to operate between two discreet speeds with switch or relay connected to the dry contact.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

A. Suspended Cabinet Fans: Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

B. Install backdraft dampers on inlet to roof exhaust fans.

C. Install destratification fans per manufacturer's instructions. Intake to be mounted 12 to 18 inches below ceiling deck.

D. Install safety screen where inlet or outlet is exposed.

3.3 DEMONSTRATION

A. Demonstrate fan operation and maintenance procedures.

3.4 PROTECTION OF FINISHED WORK

A. Do not operate fans until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

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SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Round Ceiling Diffusers
2. Rectangular Ceiling Diffusers.
3. Ceiling Supply Registers/Grilles.
4. Exhaust and Return Registers and Grilles.
5. Louvers.

B. Related Sections:
1. Section 23 09 00 - Instrumentation and Control for HVAC: Operators for adjustable louvers.
2. Section 23 33 00 - Air Duct Accessories: Volume dampers for inlets and outlets.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:
1. AMCA 500 - Laboratory Methods of Testing Louvers for Rating.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 70 - Method of Testing the Performance of Air Outlets and Air Inlets.

C. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 SUBMITTALS

A. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

C. Test and rate louver performance in accordance with AMCA 500.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 -- PRODUCTS

2.1 RECTANGULAR CEILING DIFFUSERS

A. Manufacturers:
1. E. H Price Company.
2. Krueger.

3. Nailor Industries, Inc.
4. Titus.
5. Tuttle and Bailey.

B. (Type A) Ceiling Diffuser:
1. Type: Square, fixed pattern, stamped, multi-louvered diffuser to discharge air in 360 degree four-way pattern.
2. Frame: Inverted T-bar type.
3. Fabrication: Steel with baked enamel finish. Refer to Drawings for color.

2.2 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

A. Manufacturers:
1. E. H Price Company.
2. Krueger.
3. Nailor Industries, Inc.
4. Titus.
5. Tuttle and Bailey.

B. (Type B) Egg Crate:
1. Type: Fixed grilles of 3/4 x 3/4 inch blades.
2. Fabrication: Steel with factory finish. Refer to Drawings for color.
3. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. (Type D) Grille:
1. Type: Fixed grilles of 3/4 x 3/4 inch louvers.
2. Fabrication: Steel with factory finish. Refer to Drawings for color.
3. Frame: 1-1/4 inch margin with countersunk screw mounting.
4. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.3 SUPPLY REGISTERS/GRILLES

A. Manufacturers:
1. E. H Price Company.
2. Krueger.
3. Nailor Industries, Inc.
4. Titus.
5. Tuttle and Bailey.

B. (Type C) Supply Grille:
1. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.
2. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
3. Fabrication: Steel extrusions with factory finish. Refer to Drawings for Color.
4. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.4 DUCT-MOUNTED EXHAUST AND RETURN REGISTERS/GRILLES

A. Manufacturers:
1. E. H Price Company.
2. Krueger.
3. Nailor Industries, Inc.
4. Titus.
5. Tuttle and Bailey.

B. (Type D or F) Return/Exhaust Grille:

1. Type: Fixed grilles of 3/4 x 3/4 inch louvers.
2. Fabrication: Steel or aluminum with factory finish. Refer to Drawings for color.
3. Frame: 1-1/4 inch margin with countersunk screw mounting.
4. Finish: Factory finish. Refer to Drawings for color.
5. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.5 LOUVERS

A. Manufacturers:
1. Greenheck Corp.
2. Pottorff.
3. Ruskin Manufacturing.
4. United Enertech.

B. Product Description: Stationary, Drainable.

C. Type: 6 inch deep with blades on 45 degree slope, heavy channel frame.

D. Fabrication: 12 gage thick extruded aluminum, welded assembly

E. Finish: Verify with Architect.

F. Bird Screen: Bird screen with 3/4 inch.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify inlet and outlet locations.

B. Verify ceiling and wall systems are ready for installation.

3.2 INSTALLATION

A. Install diffusers to ductwork with airtight connection.

B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00.

C. Paint visible portion of ductwork behind air outlets and inlets matte black.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

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SECTION 23 54 00 - FURNACES

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Gas Fired Furnaces.
2. Evaporator Coil Units.
3. Condensing Units.

B. Related Sections:
1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
2. Section 23 11 23 - Facility Natural-Gas Piping: Execution requirements for natural gas piping specified in this section.
3. Section 23 31 00 - HVAC Ducts and Casings: Execution requirements for ductwork and duct liner specified by this section.
4. Section 23 33 00 - Air Duct Accessories: Execution requirements for flexible duct connections specified by this section.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI Z21.47 - Gas-Fired Central Furnaces.
2. ANSI Z83.8 - Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces.

B. Air-Conditioning, Heating, & Refrigeration Institute:
1. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
2. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
3. AHRI 520 - Performance Rating of Positive Displacement Condensing Units.
4. AHRI 610 - Performance Rating of Central System Humidifiers for Residential Applications.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 15 - Safety Standard for Refrigeration Systems.
2. ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
4. ASHRAE 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.

D. National Electrical Manufacturers Association:
1. NEMA MG 1 - Motors and Generators.

E. National Fire Protection Association:
1. NFPA 54 - National Fuel Gas Code.
2. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
3. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
4. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.

F. Underwriters Laboratories Inc.:
1. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical.
2. UL 726 - Standard for Oil-Fired Boiler Assemblies.
3. UL 727 - Standard for Oil-Fired Central Furnaces.

4. UL 729 - Standard for Oil-Fired Floor Furnaces.

G. United States Department of Energy:
1. DOE 10 CFR 430.B Appendix N - Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers.

1.3 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.4 SUBMITTALS

A. Product Data: Submit rated capacities, efficiencies, weights, required clearances, and location and size of field connections, accessories, electrical nameplate data, and wiring diagrams.

B. Design Data: Indicate refrigerant pipe sizing.

C. Manufacturer's Installation Instructions: Submit rigging, assembly, and installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and connections.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, service instructions, installation instructions, maintenance and repair data, and parts listing.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Furnace Performance Requirements: Conform to minimum efficiency prescribed by ASHRAE 90.1 when tested in accordance with the following:
1. Furnaces with input capacity less than 225,000 Btu/h: DOE 10 CFR 430.B Appendix N
2. Gas-Fired furnaces: ANSI Z21.47
3. Oil-Fired furnaces: UL 727

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept furnaces and condensing units on site in factory packaging. Inspect for damage.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install condensing unit foundation pad when ground is frozen or muddy.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Furnish five year manufacturer’s warranty for heat exchangers, condensing units, and compressors.

PART 2 -- PRODUCTS

2.1 GAS FIRED FURNACES

A. Manufacturers:

1. Daikin.
2. Carrier.
3. Bryant.
4. Trane.
5. York.

B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating element, controls, air filter and accessories; wired for single power connection with control transformer.
1. Air Flow Configuration: Upflow.
2. Fuel: Natural gas fired.
3. Electric Refrigeration: Refrigerant cooling coil and outdoor package containing compressor, condenser coil and condenser fan.
4. Accessories: Roof termination kit or wall termination kit.

C. Cabinet: Steel with baked enamel finish, easily removed and secured access panels with safety interlock switches for furnaces installed indoors, insulation.

D. Supply Fan: Centrifugal type, direct drive, statically and dynamically balanced. Soft mounted to blower housing.

E. Motor: Direct drive ECM, fixed speed constant torque (FCT), permanently lubricated.

F. Heat Exchanger: Stainless steel crimped or welded construction.

G. Gas Burner:
1. Atmospheric type with adjustable combustion air supply.
2. Gas valve single-stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety ignition system, manual On-Off valve, pilot filtration, automatic electric valves.
3. Electronic or pilot ignition, with silicon nitride igniter.
4. Corrosion resistant combustion air blower with permanently lubricated motor.

H. Gas Burner Safety Controls:
1. Ignition and flame-sensing safety controls to prove adequate combustion air supply and stop gas flow on ignition failure.
2. Flame rollout switch: Installed on burner box and prevents unsafe operation.
3. Blocked Vent shutoff system: Temperature sensor installed on draft hood and prevents operation, manual reset.
4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive outlet air temperature, automatic resets.

I. Operating Controls:
1. Room Thermostat: Cycles furnace system on and off to maintain room temperature setting.
2. Supply Fan Control: Energize from outlet air temperature or timer device independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation. Provide continuous low or high speed fan operation.

J. Air Filters: 1 inch thick disposable type arranged for easy replacement.

K. Performance:
1. Ratings: Seasonal Efficiency Rating not less than requirements of ASHRAE 103.
2. Refer to Furnace Schedule. Gas heating capacities are sea level ratings.

2.2 CONDENSING UNITS

A. Manufacturers:
1. Daikin.
2. Carrier.
3. Bryant.
4. Trane.

5. York.

B. Construction and Ratings: In accordance with AHRI 210/240. Testing: ASHRAE 15.

C. Compressor: hermetic, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Furnish time delay control to prevent short cycling.

D. Refrigeration Accessories: Filter Drier, high-pressure switch (manual reset), low-pressure switch (automatic reset), service valves and gage ports and thermometer well (in liquid line). Furnish thermostatic expansion valves. Furnish refrigerant piping, factory cleaned, dried, pressurized and sealed, with insulated suction line.

E. Air Cooled Condenser: aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

F. Refrigeration Operating Controls:
1. Room Thermostat: Cycles condensing unit and supply fan to maintain room temperature setting.

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Motors: In accordance with Section 23 05 13.

B. Disconnect Switch: Mount switch on or near equipment. Coordinate with Division 26.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify building is ready for installation of units and openings are as indicated on Drawings.

3.2 INSTALLATION

A. Install gas fired furnaces in accordance with Minnesota Mechanical Code, Minnesota Fuel Gas Code, and NFPA 54.

B. Mount air cooled condenser-compressor package on concrete pads or accessory pads.

C. Installation - Natural Gas Piping:
1. Connect natural gas piping in accordance with NFPA 54.
2. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
3. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23.
a. Shutoff valve.
b. Pressure reducing valve.

D. Pipe drain from cooling coils and gas-fired furnaces heat exchanger and vent condensate disposal to nearest floor drain.

E. Connect units to electric supply and connect controls remote from units.

F. Install control components supplied with equipment and provide control wiring.

G. Install control wiring and conduit between thermostat, indoor unit, and outdoor unit.

H. Install evaporator unit in section of lined ductwork fastened to furnace. Connect return air and evaporator unit duct to system ductwork with flexible duct connection. Refer to Section 23 33 00.

END OF SECTION

SECTION 23 55 00 – FUEL-FIRED HEATERS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Gas fired unit heaters.

B. Related Sections:
1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers for placement by this section.
2. Section 23 09 00 - Instrumentation and Control for HVAC: Product requirements for thermostats and time clocks for placement by this section.
3. Section 23 11 23 - Facility Natural Gas Piping: Product requirements for natural gas piping connected to gas-fired heaters.
4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI Z83.8 - Gas Unit Heaters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. National Fire Protection Association:
1. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
2. NFPA 54 - National Fuel Gas Code.
3. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
4. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
5. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.

1.3 SUBMITTALS

A. Shop Drawings: Indicate assembly, required clearances, and locations and sizes of field connections.

B. Product Data: Submit manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Manufacturer's Installation Instructions: Submit Indicate rigging and assembly.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of thermostats or other products not mounted on unit.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept heaters and controls on site in factory packaging. Inspect for damage.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 -- PRODUCTS

2.1 GAS FIRED UNIT HEATERS

A. Manufacturers:
1. Reznor.
2. Modine.
3. Sterling.
4. Rheem.
5. Trane Company.
6. Substitutions: Approved equals.

B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories:
1. Heating fuel: Natural gas fired.
2. Discharge Louvers: Individually adjustable horizontal louvers to match cabinet finish.
3. Downturn Nozzle: 30-degree nozzle to match outlet and cabinet finish.
4. Poly-Tube Outlet Adapter: Transition duct to adapt from unit outlet to round outlet flange for polyethylene tube duct.
5. Air Filters: Filter cabinet with 1-inch thick glass fiber, disposable type filters.
6. Gas Control: Single-stage.
7. Ignition System: Electric direct ignition.
8. Control Voltage: 115 volt, 60 hertz.
9. Location: Suspended overhead.

C. Cabinet: Galvanized steel, easily removed and secured access panels, insulated or double panel construction.

D. Supply Fan: Centrifugal forward curved type with direct drive.

E. Heat Exchanger: Aluminized steel welded construction.

F. Gas Burner: Separated combustion. Power-vented with non-corrosive air blower with permanently lubricated motor.

G. Gas Burner Safety Controls:

1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
2. Flame rollout switch: Installed on burner box and prevents operation.
3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic reset.

H. Performance:
1. See Drawings.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify space is ready for installation of units and openings are as indicated on shop drawings.

3.2 INSTALLATION

A. Install units in accordance with NFPA 90A and NFPA 90B gas fired units to NFPA 54.

B. Install vent connections in accordance with NFPA 211. Install vents and stacks. Refer to Section 23 51 00.

C. Install unit heaters with vibration isolation. Refer to Section 23 05 48.

D. Installation – Natural Gas Piping:
1. Connect Natural gas piping in accordance with NFPA 54.
2. Connect Natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
3. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23.
   a. Strainer.
   b. Pressure gage.
   c. Shutoff valve.

E. Provide hangers and supports for suspended units. Refer to Section 23 05 29.

F. Provide operating controls. Refer to Section 23 09 00.

G. Provide connection to electrical power systems.

END OF SECTION

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SECTION 23 63 13 - AIR-COOLED REFRIGERANT CONDENSERS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section includes refrigerant condenser package, charge of refrigerant and oil, controls and control connections, refrigerant piping and connections, motor starters, electrical power connections.

B. Related Sections:
1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolation for placement by this section.
3. Section 23 23 00 - Refrigerant Piping: Execution requirements for connection to refrigerant piping specified by this section.

1.2 REFERENCES

A. Air-Conditioning, Heating, & Refrigeration Institute:
1. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
2. AHRI 340/360 - Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
3. AHRI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
4. AHRI 460 - Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
2. ASHRAE 20 - Method of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Underwriters Laboratories Inc.:
1. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical.

1.3 DEFINITIONS

A. Energy Efficiency Ratio (EER) - Ratio of net cooling capacity in Btuh to total rate of electric input in watts under designated operating conditions.

B. Integrated Energy Efficiency Ratio (IEER): Single-number figure of merit expressing cooling part-load efficiency for commercial unitary air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

C. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling (in Btu) divided by total electric energy input during the same period (in Wh).

1.4 SUBMITTALS

A. Shop Drawings: Indicate components, assembly, dimensions, weights and loading, required clearances, and location and size of field connections. Include schematic layouts showing condenser, refrigeration compressors, cooling coils, refrigerant piping and accessories required for complete system.

B. Product Data: Submit rated capacities, weights, accessories, electrical requirements, and wiring diagrams.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.6 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Construction and Ratings: In accordance with AHRI 210/240, AHRI 340/360, AHRI 365, and AHRI 460, as required. Testing in accordance with ASHRAE 20 and UL 207.

C. Performance Ratings: Conform to minimum EER and IEER (alternatively SEER or Btu/h-HP as applicable) values not less than prescribed by ASHRAE 90.1 when tested in accordance with AHRI 210/240, AHRI 340/360, AHRI 365, and AHRI 460, as applicable.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

B. Protect units on site from physical damage.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Furnish five year manufacturer warranty for compressors.

PART 2 -- PRODUCTS

2.1 CONDENSING UNITS

A. Manufacturers:
1. Carrier Corp.
2. The Trane Co.
3. York (JCI).
4. Daikin.
5. AAON.
6. First Company.

B. Product Description:
1. Packaged, factory assembled, pre-wired unit, suitable for outdoor use consisting of casing, condensing coil and fans, integral sub-cooling coil, and controls.

2.2 HOUSING

A. House components in steel panels with weather resistant, baked enamel finish.

B. Mount starters, disconnects, and controls in weatherproof panel with full opening access doors. Furnish mechanical interlock to disconnect power when door is opened.

C. Furnish removable access doors or panels with quick fasteners.

D. Furnish welded steel floor mounting stand and duct collars at coil inlet and fan outlet.

2.3 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Furnish sub-cooling circuits as applicable. Air test under water to 425 psig, and dehydrate. Seal with holding charge of refrigerant.

B. Coil Guard: Expanded metal.

C. Configuration: Single refrigeration circuit or Two refrigeration circuits each.

2.4 FANS AND MOTORS

A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built-in current an] thermal overload protection .

2.5 CONTROLS

A. Factory wired and mounted control panel, NEMA 250 Type 1 enclosure, containing fan motor starters, fan cycling thermostats, compressor interlock and control transformer.

B. Furnish controls to permit operation down to 0 degrees F ambient temperature.

C. Furnish thermostat to cycle fan motors in response to outdoor temperature.

D. Furnish head pressure switch to cycle fan motors in response to refrigerant condensing pressure.

E. Furnish solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.

F. Furnish electronic low ambient control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.

2.6 CONDENSING UNIT PERFORMANCE

A. Refer to Drawing Schedules.

2.7 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with Division 26 and Drawing Schedules:

B. Motors: In accordance with Section 23 05 13.

C. Disconnect Switch: Factory mount disconnect switch in on equipment.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Install in accordance with ASHRAE 15.

B. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties furnished with unit. Refer to Section 23 23 00.

C. Install connection to electrical power wiring in accordance with Division 26.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Install units on vibration isolators on concrete foundations. Refer to Section 23 05 48.

3.3 DEMONSTRATION AND TRAINING

A. Demonstrate starting, maintenance, and operation of unit.

B. Demonstrate low ambient operation during winter testing or service specified above.

END OF SECTION

SECTION 23 75 23 - PACKAGED MAKE-UP AIR UNITS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Direct natural gas-fired make-up air units.
2. Electric make-up air units.
3. Integral controls.

B. Related Sections:
1. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
2. Section 23 11 23 - Facility Natural-Gas Piping.
3. Section 23 33 00 – Air Duct Accessories.
4. Division 26 - Electrical: Power wiring and branch circuit protection to units.

1.2 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

B. Make-up air units are 100 percent outside air units with heating type (direct gas-fired or electric), airflow, and fan speed control (single-speed or two-speed) as indicated on Drawing Schedules.

1.3 SUBMITTALS

A. Product Data:
1. Airflow and heating capacities, including temperature rise. For direct gas-fired units, include maximum and minimum burner input and required gas supply pressure. For electric units, include kW and number of heating stages.
2. Fan curves and total static pressure breakdown by component.
3. Dimensions.
4. Weights.
5. Rough-in connections and connection requirements.
6. Duct connections.
7. Electrical requirements with electrical characteristics and connection requirements, including unit FLA, MCA, MOP, and short-circuit current rating (SCCR).
8. Controls, including wiring diagrams and sequence of operation.
9. Accessories, identifying items shipped loose for field installation.

B. Manufacturer’s Installation Instructions: Submit assembly, support details, connection requirements and start-up instructions.

C. Manufacturer’s Field Reports: Submit start-up report for each unit.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of controls installed remotely from units.

B. Operation and Maintenance Data: Submit manufacturer’s descriptive literature, operating instructions, installation instructions and maintenance and repair data.

1.5 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Direct Gas-Fired Units: Design certified and labeled by a nationally recognized testing laboratory in accordance with ANSI Z83.4/CSA 3.7.

C. Electric Units: Listed and labeled by a nationally recognized testing laboratory in accordance with UL 1995/CSA C22.2 No. 236.

D. Sound Rating: In accordance with AHRI 270.

E. Damper Performance: Test in accordance with AMCA 500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept units on-site in original factory packaging. Inspect for damage.

B. Store units and components shipped loose in clean, dry location protected from weather until installation.

1.8 WARRANTY

A. Provide 1-year warranty on all parts and labor.

B. Direct Gas-Fired Units: Provide extended 5-year burner warranty.

PART 2 -- PRODUCTS

2.1 PACKAGED MAKE-UP AIR UNITS

A. Manufacturers:
1. Greenheck.
2. Captive Aire.
3. Reznor.
4. Rupp.
5. Titan.

B. Product Description: Self-contained, packaged, factory-assembled and wired, including:
1. Cabinet.
2. Supply fan.
3. Heating section: Direct natural gas-fired or electric, as scheduled.
4. Air filters.
5. Controls.
6. Discharge damper.
7. Accessories.

C. Cabinet:
1. Designed for outdoor installation with weatherproof, single-wall insulated construction.
2. Panels: Constructed of G90 galvanized steel.
3. Furnish gasketed, hinged access doors.
4. Insulation: Factory-applied to cabinet panels in the conditioned airstream. One-inch thick, 1.5 lb/cu. ft. density glass fiber with edges protected from erosion.
5. Insulated control vestibule with vestibule heater package.

D. Supply Fan:
1. Double width, double inlet, forward curved centrifugal type.

2. V-belt drive with matched set belts, rated for 125% motor horsepower.
3. L-100,000 bearings.
4. Shaft design for maximum operations speed not to exceed 75% of its first critical speed.
5. Tested in accordance with AMCA 210.
6. Blower and motor mounted on neoprene vibration isolators.
7. Motor:
    a. Open drip-proof (ODP), 1750 rpm.
    b. Premium-efficiency.
    c. Motor overload protection by unit VFD.

E. Direct Gas-Fired Heating Section:
1. Fuel: Natural gas.
2. Burner: Direct fire type burner with adjustable profile plates, pressure regulator, modulating gas valve, manual shut-off valves, redundant safety shut-off valves, intermittent spark ignition, flame sensing device, and automatic 100 percent shut-off pilot.
3. Turndown: Minimum 25:1.
4. Flame safeguard control with pre-purge, low fire start, and manual reset on flame failure.
5. Airflow switches to prove airflow across the burner profile before allowing gas valve to open and to shut down the burner if airflow exceeds design parameters.
6. High gas pressure switch, manual reset.
7. High temperature limit, manual reset.
8. Vent gas train components requiring venting to outdoors unless fitted with approved vent limiters.

F. Electric Heating Section:
1. Factory-installed electric heating coil, sized for temperature rise and kW indicated on Drawing Schedules.
2. Heating elements sub-fused per stage in accordance with NEC.
3. Automatic reset primary high temperature limit and manual reset secondary high temperature limit.
4. Airflow proving interlock to prevent heater operation without proven airflow.
5. Single point power connection for heater and fan.

G. Air Filters: 2-inch thick cleanable, permanent metal media filters in G90 galvanized steel V-bank outside air filter section. Filter section shipped loose for field installation.

H. Outside Air Intake Hood:
1. Punched louvered type, G90 galvanized steel.
2. Sized for 100% air flow rate.
3. Shipped loose for field installation.

I. Discharge Damper:
1. Low leakage type with vertical blades, G90 galvanized steel frame and blades.
2. Factory-furnished damper actuator, interlocked to open before supply fan start.
3. Shipped loose for field installation.

J. Controls:
1. Furnish terminal strip on unit for connection of operating controls to remote panel.
2. Discharge air temperature control with discharge air temperature sensor and remote setpoint adjustment.
3. Room override thermostat to reset discharge air temperature upward on a call for heat.
4. Direct Gas-Fired Units: Modulating gas valve controlled to maintain discharge air temperature setpoint. Inlet air temperature sensor to disable burner above adjustable outdoor air temperature setpoint.
5. Electric Units: DDC controller for discharge temperature control with staged electric heat, low temperature safety, warm outdoor air heat shutdown, and 7-day occupancy schedule.

6. Low temperature safety to shut down unit when discharge air temperature remains below setpoint for an adjustable time period.
7. Clogged filter switch.
8. Remote Control and Status Panel: Furnish remote panel, NEMA 1, shipped loose, containing the following control and status indicators:
    a. Unit operating and heating mode lights.
    b. Discharge air temperature setpoint adjustment, 55 F to 90 F (adj.).
    c. Room temperature thermostat (remote sensor required).
    d. Dirty filter indicator light.
    e. Fan only operation and indicator light.
    f. High/low speed switch for units with two-speed operation.
9. Factory-mounted VFD with vent package, for all units. Where two-speed operation is scheduled, VFD shall provide two-speed control, 100% and 50% airflow rates, as indicated in sequence of operation. See sequence of operation for control interface.
10. 120V/24V smoke detector to be furnished with unit.
11. Provide air-flow proving contact.
12. Provide start-stop signal for exhaust fan operation. Control relay contacts shall close to start exhaust fan when unit airflow is proven.
    a. Exhaust fan speed modulation.

K. Capacity: As indicated on drawing schedules.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: As indicated on Drawing Schedules.

B. Disconnect Switch: Factory-mounted, door-interlocked, non-fused disconnect.

C. VFD Branch Circuit Protection: Where not furnished by unit manufacturer, fuses or circuit breaker for VFD shall be furnished and installed under Division 26. Coordinate requirements with Division 26.

D. Short-Circuit Current Rating: Unit SCCR shall be coordinated with the available fault current at the unit as determined under Division 26.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify building systems to be controlled are ready to operate.

B. Verify air handling units and ductwork have been accepted and air filters are in place before installing sensors in air streams.

C. Verify location of thermostats and other exposed control sensors with Drawings before installation.

3.2 INSTALLATION

A. Concrete Base:
    1. Provide concrete pad.
    2. Pour base to extend beyond unit by 6-inches on all sides.

B. Provide steel structure to support unit minimum of 36” above concrete base.

C. Connect units to supply air ductwork with flexible connections. Refer to Section 23 33 00.

D. Install components furnished loose for field-mounting, including outside air intake hood, filter section, and discharge damper.

E. Install electrical devices furnished loose for field-mounting.

F. Install control wiring between unit and field-installed accessories:

1. Provide remote temperature sensor suitable for Class 1 Division 2 application (explosion-proof).
2. Locate remote temperature sensor at 60-inches above the floor.
3. Factory damper actuator(s).
4. Remote control and status panel.

3.3 INSTALLATION – DIRECT GAS-FIRED HEATING SECTION

A. Connect natural gas piping in accordance with IFGC.

B. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.

C. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23:
1. Shutoff valve.
2. Dirt leg.
3. Union.
4. Pressure regulator.

D. Vent gas train regulators and pressure switches to outdoors where not fitted with approved vent limiters.

3.4 INSTALLATION – ELECTRIC HEATING SECTION

A. Coordinate single point power connection and branch circuit protection with Division 26.

B. Verify heating element stage fuses are installed and airflow proving interlock is operational before energizing heater.

3.5 MANUFACTURER'S FIELD SERVICES

A. Furnish initial start-up and shut-down during first year of operation, including routine servicing and checkout.

B. Complete manufacturer's start-up checklist and return to manufacturer within the time required to maintain full warranty coverage.

3.6 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

B. Clean permanent filters in accordance with manufacturer's instructions at Substantial Completion.

3.7 DEMONSTRATION

A. Demonstrate complete operation of systems, including Sequence of Operation prior to Date of Substantial Completion.

B. Demonstrate unit maintenance to Owner.

END OF SECTION

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SECTION 23 81 26 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:
1. Indoor fan coil section.
2. Outdoor condensing unit.

B. Related Sections:
1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Vibration isolators.
2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation applying to units in this section.
3. Section 23 23 00 - Refrigerant Piping: Execution requirements for connection to refrigerant piping specified by this section.
4. Section 23 33 00 - Air Duct Accessories: Flexible connections.

1.2 REFERENCES

A. Air-Conditioning, Heating, & Refrigeration Institute:
1. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. National Electrical Manufacturers Association:
1. NEMA MG 1 - Motors and Generators.

D. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.3 DEFINITIONS

A. Energy Efficiency Ratio (EER2) - Ratio of net cooling capacity in Btuh to total rate of electric input in watts under designated operating conditions.

B. Integrated Energy Efficiency Ratio (IEER): Single-number figure of merit expressing cooling part-load efficiency for commercial unitary air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

C. Seasonal Energy Efficiency Ratio (SEER2) - Total cooling output of an air conditioner during its normal annual usage period for cooling (in Btu) divided by total electric energy input during the same period (in Wh).

1.4 SYSTEM DESCRIPTION

A. The Mechanical Contractor is responsible for items in this Section.

1.5 SUBMITTALS

A. Product Data: Submit data indicating:
1. Cooling and heating capacities.
2. Dimensions.

3. Weights.
4. Rough-in connections and connection requirements.
5. Duct connections.
6. Electrical requirements with electrical characteristics and connection requirements.
7. Controls.
8. Accessories.

B. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of controls installed remotely from units.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.7 QUALITY ASSURANCE

A. Perform Work in compliance with all applicable codes and standards enforced by the Authority Having Jurisdiction, as well as all applicable laws, ordinances, and regulations.

B. Split System Air Conditioners, less than 65,000 Btu/h cooling capacity, air-cooled:
1. Cooling Capacity: Rate in accordance with AHRI 210/240.
2. Performance Requirements: Conform to minimum SEER values prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with AHRI 210/240.

C. Sound Rating: Measure in accordance with AHRI 270.

D. Insulation and adhesives: Meet requirements of NFPA 90A.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

B. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

C. Protect units from weather and construction traffic by storing in dry, roofed location.

1.10 WARRANTY

A. Furnish five year manufacturer’s warranty for unit and seven year warranty for compressors.

PART 2 -- PRODUCTS

2.1 MINI-SPLIT SYSTEM AIR-CONDITIONING UNITS

A. Manufacturers:
1. Daikin Industries, Ltd.
2. Lennox International Inc.
3. LG Electronics.
4. Mitsubishi Electric Corporation.
5. The Trane Company.

6. HAIER Company.

B. Product Description: Split system consisting of:
   1. Compact indoor fan coil section with wired thermostat.
   2. Condensing unit including inverter-driven cooling only or heat pump design. See equipment schedule.

2.2 INDOOR FAN COIL SECTION

A. Cabinet:
   1. Panels: Constructed of galvanized steel with baked enamel finish.
   2. Installation Plate: Separate installation plate to securely attach indoor unit to wall.

B. Evaporator Fan: Resiliently mounted with direct drive and high efficiency motor. Motor permanently lubricated with built-in thermal overload protection.

C. Evaporator Coil: Constructed of copper tubes expanded onto aluminum fins. Factory leak tested under water. Removable, sloped drain pan with piping connections on both sides.

D. Air Filters: Pleated-type filter and washable-type pre-filter.

2.3 OUTDOOR CONDENSING UNIT

A. General: Factory assembled and tested air-cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls.

B. Unit Casings: Exposed casing surfaces constructed of galvanized steel with manufacturer's standard finish. Designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives.

C. Compressor: High performance, hermetic, inverter driven, variable speed, dual rotary type compressors, resiliently mounted, with positive lubrication, and internal motor overload protection.
   1. Motor: Direct current (DC) type equipped with factory-mounted inverter drive package.

D. Condenser Coil: Constructed of copper tubing mechanically bonded to aluminum or copper fins, factory leak and pressure tested.
   1. Expansion Valve: Electronically controlled, precision linear type.

E. Controls: Furnish operating and safety controls including high and low pressure cutouts. Control transformer. Furnish magnetic contactors for compressor and condenser fan motors.

F. Condenser Fans and Drives: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Direct current (DC), high-efficiency motors with permanently lubricated ball bearings, built-in thermal overload protection, and raised guard to prevent contact with moving parts.

G. Condensing Unit Accessories: Furnish the following accessories:
   1. Controls and wind baffle to provide low ambient cooling to -20 degrees F.
   2. Disconnect switch.
   3. Condenser Coil Guard: Condenser fan openings furnished with safety guards.
   4. Suction and discharge pressure gauges.
   5. Provide wall mounting or mini-split stand to elevate unit from ground where specified.

H. Refrigeration specialties: Furnish the following for each circuit:
   1. Refer to manufacturer’s instructions.

I. Refrigerant: Furnish charge of refrigerant as recommended by equipment manufacturer in accordance with current EPA requirements.

2.4 REFRIGERANT PIPING

A. Refer to Section 23 23 00.

2.5 CONTROLS

A. Indoor Fan Coil Section: Capable of self-diagnostic function and Check Mode switching. Capable of sensing return air temperature and indoor coil temperature. Capable of providing emergency operation and controlling of outdoor condensing unit.

B. Restart: System capable of automatic restart and operation at previously selected mode when power is restored after power interruption.

C. Remote Controller: wired or wireless, 7-day programmable electronic space thermostat with heating and cooling with automatic changeover and heating setback and cooling setup capability. Furnish system selector switch cool-dry-auto-fan-heat and fan speed selector for hi-mid-low.
   1. Display
      a. Operating Conditions: Setpoint and room temperature, refrigerant temperatures, running current
      b. Error: Display error codes and indoor/outdoor unit affected.

2.6 CAPACITY

A. Unit Sound Rating: Maximum 55 dBA measured 3 feet from casing.

B. Refer to Drawings for other capacity and performance values.

2.7 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with Division 26 and the Drawing Schedules:

B. Indoor Fan Coil Section: Powered directly from outdoor condensing unit.

C. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verify concrete pad for condensing unit is ready for unit installation.

3.2 INSTALLATION - INDOOR FAN COIL SECTION

A. Install indoor fan coil units on vibration isolators. Refer to Section 23 05 48.

B. Install condensate piping with trap and route from drain pan to nearest code approved plumbing receptor or as noted on drawings. Refer to Section 23 21 13.

C. Install components furnished loose for field mounting.

D. Install connection to electrical power wiring in accordance with Division 26.

3.3 INSTALLATION - OUTDOOR CONDENSING UNIT

A. Install condensing units on vibration isolators. Refer to Section 23 05 48.

B. Install units on concrete foundations. Refer to Division 03.

C. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties furnished with unit. Refer to Section 23 23 00.

D. Evacuate refrigerant piping and install initial charge of refrigerant.

E. Install electrical devices furnished loose for field mounting.

F. Install control wiring between indoor fan coil section, outdoor condensing unit, and field installed accessories.

G. Install connection to electrical power wiring in accordance with Division 26.

3.4 MANUFACTURER'S FIELD SERVICES

A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.5 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

B. Clean permanent, cleanable filters at Substantial Completion.

3.6 DEMONSTRATION AND TRAINING

A. Demonstrate indoor fan coil section operation and maintenance.

B. Demonstrate starting, maintenance, and operation of outdoor condensing unit.

3.7 PROTECTION OF FINISHED WORK

A. Do not operate indoor fan coil section until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. Section Includes, but not limited to:
   1. General Requirements for Electrical
   2. Equipment and Materials
   3. General Workmanship and Installation Requirements for Electrical.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 0 and Division 01 Specification Sections apply to this Section.

B. Division 26: Electrical

C. Where a Specification Section refers to other Sections under the Article on Related Sections, this is done for Contractor's convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.3 REGULATORY REQUIREMENTS

A. Meet or exceed all current applicable codes, ordinances, and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:
   1. Energy Codes and Standards:
      a. International Energy Conservation Code (IECC)
      b. Illuminating Engineering Society of North America (IESNA)
      c. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE 90.1)
   2. International Code Council:
      a. International Building Code (IBC)
      b. International Fire Code (IFC)
   3. National Fire Protection Association Codes and Standards:
      a. NFPA 70 - National Electrical Code
      b. NFPA 72 - Fire Alarm Code
      c. NFPA 101 - Life Safety Code
   4. National Electrical Safety Code (ANSI C2)
   5. City, State and Local Building Codes and Ordinances
   6. City, State and Local Fire Codes and Regulations
   7. Occupational Safety and Health Administration Regulations (OSHA)
   8. Americans with Disabilities Act (ADA)
   9. Uniform Federal Accessibility Standards
   10. State Department of Health Codes and Regulations
   11. Testing Agencies:
      a. Underwriters Laboratory
      b. Intertek ETL

1.4 REFERENCES

A. Use the latest edition of the standard or the edition required by governing code where referenced in the specifications by the following abbreviations:
   1. ANSI American National Standards Institute:
      a. C2 - National Electrical Safety Code.
      b. C62.41-IEEE - Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
   2. ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers
   3. CBM – Certified Ballast Manufacturer
   4. EPA-Environmental Protection Agency
   5. ETL – Electrical Testing Laboratory
   6. ICEA - Insulated Cable Engineers Association:
      a. S-95-658 - Thermoplastic-Insulated Wire and Cable.
      b. S-65-375 - Rubber-Insulated Wire and Cable.
   7. IEEE Institute of Electrical and Electronic Engineers:
      a. 112 - Standard Test Procedure for Polyphase Induction Motors and Generators.
      b. 519 - Recommended Practices and Requirements for Harmonic Control In Electric Power Systems.
   8. IES - Illuminating Engineering Society
   9. NBFU - National Board of Fire Underwriters
   10. NECA – National Electrical Contractor's Association:
      a. NECA 1 - Standard Practices for Good Workmanship In Electrical Contracting.
   11. NEC - National Electrical Code
   12. NECA – National Electrical Contractors Association:
      a. NECA 101 – Standard for Installing Steel Conduit
      b. NECA 102 – Standard for Installing Aluminum Rigid Metal Conduit.
      c. NECA 111 – Standard for Installing Nonmetallic Raceways (RNMC, LFNC).
   13. NEMA National Electrical Manufacturers Association:
      a. TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
      b. MG 1 - Motors and Generators.
      c. PB 2 - Deadfront Distribution Switchboards.
      d. ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2,000 Volts AC or 750 Volts DC.
      e. 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
      f. WC 5 - (See ICEA S-95-658).
      g. WC 7 - (See ICEA S-95-658).
   14. NESC – National Electric Safety Code
   15. NFPA National Fire Protection Association
   16. OSHA Occupational Safety and Health Administration:
      a. 29 CFR 1910 - Occupational Safety and Health Standards.
   17. UL Underwriters' Laboratories, Inc.:
      a. UL-6 - Rigid Metal Conduit.
      b. UL-83 - Thermoplastic - Insulated Wires and Cables.
      c. UL-360 - Liquid-Tight Flexible Steel Conduit.
      d. UL-467 - Electrical Grounding and Bonding Equipment.
      e. UL 486D - Insulated Wire Connector Systems for Underground Use or In Damp or Wet Locations.
      f. UL-508 - Industrial Control Equipment.
      g. UL-651 - Schedule 40 and 80 Rigid PVC Conduit.
      h. UL-891 - Dead-Front Switchboards.
      i. UL-913 - Intrinsically Safe Apparatus and Associated Apparatus for Use In Class I, II, and III, Division 1, Hazardous (Classified) Locations.
      j. UL-1008 - Transfer Switch Equipment.
      k. UL-1012 - Power Units Other Than Class 2.

l. UL-1277 - Electrical Power and Control Tray Cables With Optional Optical Fiber Members
m. UL-1449 - Surge Protection Devices
n. UL-1479 - Fire Tests of Through-Penetration Firestops.

1.5 DEFINITIONS

A. The terms defined below apply to all work included in Division 26.
1. The work – The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.
2. Furnish – to obtain in new condition ready for installation into the work.
3. Install – to store, set in place, connect and place into operation into the work.
4. Provide – to furnish and install.
5. Connect – to bring service to the equipment and make final attachment including necessary switches, outlets, boxes, terminations, etc.
6. Conduit – includes in addition to conduit, all fittings, pull boxes, hangers and other supports and accessories related to such conduit.
7. Concealed – hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.
8. Exposed: not installed underground nor concealed as defined above.
9. Building structure or building structural members - consists of steel columns, steel beams, steel joists (top chord and at panel points), concrete walls and concrete block walls. Metal decking, joist bridging and bottom chords of bar joists shall not be construed as building structure nor as a building structural member for the purpose of support.

B. The drawing and specifications constitute the Contract Documents. Any item noted in the specification or shown on the drawings is included in the Contract Documents.

C. The contractor shall field-verify all dimensions and notify the Engineer of any conflicts or discrepancies, in writing, prior to submittals and installation. If prior notification is not provided, Contractor is responsible for resolution of all dimensional conflicts.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Initiate, maintain, and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:
1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.
2. Do not dispose of any PCB containing materials. Disposal of all PCB containing materials will be the responsibility of the Owner.

C. Provide new, first quality material for all products specified. Do not reuse materials unless indicated or approved by the Engineer.

D. Contractor shall have knowledge of latest edition of NFPA 70 (NEC) and additional governing codes. In addition to the work shown in the Contract Documents, Contractor shall provide all work to comply with these references. Additional services will not be awarded for Contractor to perform work to satisfy the AHJ inspection comments. All work is to be included in Base Bid.

E. Provide equipment specified in this section which is listed and labeled by a nationally recognized testing laboratory.

F. Comply with ANSI as applicable to equipment specified in this section.

G. Comply with NEMA as applicable to equipment specified in this section.

H. Equipment provided with SCCR ratings/labels shall be provided with sufficient SCCR values to exceed the available short circuit current at the equipment connection point. Where short circuit current is not identified in the Contract Documents, contractor is responsible for providing the necessary calculations for coordination.

1.7 PROJECT/SITE CONDITIONS

A. Site Inspections:
   1. Before submitting a proposal on the work contemplated, examine the site of the proposed work, and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.
   2. Conduits, pipes, ducts, lights, devices, speakers, etc., shown on the drawings as existing have been based on existing plans and casual site observations, and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location, and condition of such facilities prior to submitting a bid.

B. Correlation of Work:
   1. Consult the drawings and specifications of all other Divisions for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with all drawings. Notify the Engineer of any conflicts that cannot be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.
   2. Install all conduit, cable tray, busduct, equipment, etc. allowing proper code and maintenance clearances and to avoid blocking passageways and access panels.
   3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.
   4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall perform adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.
   5. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.
   6. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the drawings and specifications.

C. The Contract Documents shall govern in the instances where requirements indicated are greater than those stated in the governing codes and standards.

1.8 FIRESTOPPING

A. Provide firestopping around all new penetrations, sleeves and openings through all partitions, walls, and floors.

B. Provide UL listed components installed by a certified and factory trained personnel.

1.9 SEQUENCING AND SCHEDULING

A. Refer to General Conditions and Requirements.

1.10 EQUIPMENT INSTRUCTIONS AND PARTS LITERATURE

A. Instruction and parts literature are generally packed with electrical equipment and devices. Contractor shall remove this literature from the packing container or equipment enclosure, identify the literature with the equipment to which it applies, and file the literature in loose-leaf binders with index tabs. Each binder shall have an index which lists each piece of equipment and the literature which applies to it. An index tab shall be provided for each piece of equipment.

B. Contractor shall establish a procedure with the other trades for receiving, identifying, and filing literature for devices which are removed from their packaging and installed by other trades.

1.11 SUBMITTALS

A. Submit the following items consistent with Division 0 and Division 1. Refer to each Section under Division 26 for additional submittal requirements particular to that Section.

B. Prior Approvals:
   1. Submit approval form for each request for prior approval.
   2. Submittals shall be formally presented to the Project Engineer. Submittals presented to the Engineer prior to approval of Project Engineer will not be reviewed or accepted.
   3. Submit electronic, written requests to use unspecified items, to the Engineer, no later than four (4) calendar days prior to the bid opening. Submit detailed information for proposed material or equipment specific to the project, clearly indicating all options included in the submittal.
   4. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.
   5. Contractor is responsible for dimensional differences, electrical requirements, and any other resulting changes, when using accepted substitutions. Contractor is responsible for any additional costs incurred because of substitutions, including other contractors and Engineer fees.
   6. Material and equipment not specified or accepted in an Addendum will be removed and replaced at no cost or inconvenience to the Owner.

C. Work Scope Change:
   1. If a work scope change is requested and Contractor would like to be awarded additional compensation or a deduct from original contract is requested, Contractor shall provide a schedule of values for all associated proposed work.
      a. Pricing shall be grouped to represent each itemized work scope change.
      b. Each piece of equipment shall be itemized, along with cost of item. Labor to install said item shall be presented on a separate line item.
      c. Provide a final lump sum number for all work associated with the change and individual pricing for each item on the schedule of values.
      d. Engineer may request additional breakdown for improved clarity and Contractor must comply prior approval for the additional compensation or credit.
      e. Comply with the requirements set forth in Division 0 and Division 1.
   2. Contractor shall provide actual manufacturer and distributer invoices showing cost of work affected by the work scope change upon request of Engineer and/or Owner representative.
   3. Contractor is solely responsible for delays in schedule where Contractor is required to resubmit documentation, revise requested documentation or provide additional information associated to gaining approval for the work scope change.

D. Shop Drawings and Manufacturer's Information:
   1. Submit in accordance with the Division 0 and Division 1. Unless noted otherwise, submit drawings to the Engineer for review within 30 calendar days after award of Contract.
   2. Provide separately bound documents for each submittal for each section. Combination submittals will be returned to the Contractor without review and count as 1 submittal. Do not combine submittals from multiple sections.
   3. Include project name, name of Engineer, contractor, sub-contractor, manufacturer, supplier, and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all this information will be returned without review, and count as 1 submittal.
   4. Examine all shop drawings noting capacity, arrangement, and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information.
   5. Submittals for equipment provided by the Electrical Contractor shall bear a stamp or specific written certification from the Electrical Contractor, certifying the submittals have been reviewed and approved by the submitting Electrical Contractor.
   6. Provide the following shop drawing and manufacturer information:
      a. Product Data Sheets:

1) Product and component data sheets which describe all equipment and devices to be provided.
2) Include all features specified.
3) Provide dimensioned prints with weights.
4) Highlight or otherwise accentuate on each data sheet the specified product features and product numbers.
5) Features or part numbers which do not apply shall be struck through, crossed out, blacked out, or otherwise identified as not applicable.

b. Composite Drawing:
1) Include power and control wiring for all systems and equipment.
2) Show basic systems on composite drawing.
3) Use terminal numbers on drawings and schematics.
4) Use separate drawings to show details of sub-systems.
5) Identify sub-system drawing interface points on composite drawing and sub-system drawings; terminal numbers of interface points shall be the same on both drawings.
6) Revise or redraw manufacturer's standard drawings to meet above requirements.

c. Record all Changes to Existing Systems:
1) Revise all wiring diagrams and schematic diagrams to show final installation:
a) Includes all new and existing equipment diagrams.

d. Programmable Systems:
1) Description of programmable system operation, including but not limited to input/output functions, control capabilities, configuration procedures, starting setpoints, etc.
2) Preliminary graphic screens and reports.
a) This submittal shall occur prior to shipment of the system.

e. Manufacturers Installation Instructions:
1) Include with shipment.

7. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for material under the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is solely responsible for any project delays caused by having to resubmit submittals.

E. Operating and Maintenance Manuals:
1. Include all the information provided with the approved shop drawings and manufacturer's information.
a. Update and complete control system drawings and descriptions for all equipment.
b. All documentation shall include modifications made which reflect the final installation.
c. Provide all completed testing reports.
2. Date the manuals with the day, month, and year they are provided to the Owner/Engineer.
3. Provide manufacturers' user manuals and installation instructions.
4. Provide 3 hard (paper) copies in a 3-ring binder. Provide a table of contents and each piece of equipment or sub-system shall be tabbed.
5. Provide 2 digital copies in a PDF format saved to an USB drive. The saved files shall be clearly identified and organized in a similar manner to the hard copies
a. Data saved on the disks shall be accessible and neatly organized.
b. Provide a table of contents which utilizes bookmarks and links. The links shall take the reader to a specific page when the reader clicks on the desired title in the table of contents. A link shall be provided for materials associated with each piece of equipment included in the O&M manual.
6. Record all Changes to Existing Systems
7. Insert revised documents into the Owner's existing operation and maintenance manuals in place of original documents, if such O&M's exist.

F. Record Documents:
1. Provide three sets of hard copy record documents and two digital pdf copy. Record Drawings shall be of the same size as the original published contract drawings.

2. Shall be provided with the O&M's.
3. Record drawings shall include all work scope changes, including addenda.
4. Record drawings shall show locations of all above ceiling control devices, such as relays, contacts, control modules, monitor modules, power packs, fire/smoke detection equipment, etc.
5. Refer to Contract Documents for additional Record Drawing requirements.

PART 2 -- PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All electrical and control equipment and materials shall be provided as specified in the Contract Documents.

B. All equipment and materials shall be new and shall bear the Underwriters Laboratories (UL) label if such products are listed by UL.

C. Where applicable, equipment and materials shall conform to ANSI, ICEA, IEEE, and NEMA Standards.

2.2 HAZARDOUS LOCATIONS

A. An area identified where fire or explosion hazards may exist due to flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dusts or ignitable fibers/flyings.

B. Installations in areas identified as hazardous locations, at a minimum, meet the requirements of the latest edition of the National Electrical Code (NFPA 70). Where specifications are more conservative than the National Electrical Code requirements, the specification shall be followed.

C. Refer to drawings for hazardous location identifications.

D. All installations in Class 1, Division 1 and 2 hazardous locations shall meet the NEC requirements for a Class 1, Division 1 hazardous location. Unless noted otherwise.

2.3 CORROSIVE ENVIRONMENTS

A. Corrosive environment is an area or space which there are gases, vapors, liquids, or other material cause a caustic effect on materials, more so than standard air.

B. All products supplied in corrosive environments shall be suitable for installation and resist corrosion which may be caused by the potentially present caustic agent.

C. The following areas shall be considered as a corrosive environment.
1. Lift station wetwell
2. Pretreatment room
3. MLR wetwell
4. Aeration basin
5. Sludge storage tanks
6. RAS and SCUM wetwell
7. Clarifiers
8. Chemical rooms

PART 3 -- EXECUTION

3.1 CONSTRUCTION LIGHTING & POWER SYSTEM - REMODELING

A. Provide construction power and lighting that adheres to the NEC Article 590 – "Temporary Installations."

B. Refer to Division 1 for temporary electrical services.

C. For remodeling work in the existing building, use existing building distribution systems for construction power.

D. Replace all receptacles, switched, cover plates, etc., damaged by any Contractor during construction.

E. Materials furnished for the temporary light and power system remain Contractor's property. Remove when there is no longer any need for temporary light and power or when directed by the Project Representative.

F. Electrical energy costs shall be paid by the Owner.

3.2 PREPARATION

A. Continuity of Service:
   1. No Division 26 systems are to remain inactive at the end of the workday. Assure that the systems are all operational at the end of each workday. Coordinate temporary outages with the Owner.
   2. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.
   3. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

B. Use of Facility:
   1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.
   2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.3 INSTALLATION

A. Material and Workmanship
   1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt, and the weather.
   2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA standards.
   3. The Engineer reserves the right to reject material or workmanship not in accordance with the specifications, before or after installation.
   4. Engineer and Owner have the right to determine if equipment, boxes and covers are not accessible. Where electrical work is determined to be not accessible, Contractor shall modify the work as directed at no additional cost to the Owner.

B. Excavation and Backfilling:
   1. Provide all excavation and backfilling required to complete the installation of the electrical system.
   2. Bed all conduit and structures on a 6" thick compacted layer of granular material. Should unsatisfactory soil conditions be discovered, the Owner Representative will inspect the excavation and determine the necessary additional support required.
   3. Backfill around conduit and structures by hand using coarse sand, pit run gravel or the native material if it is like the above. Remove all large stones, frozen lumps, perishable rubbish, and excessive amounts of clay. Carefully compact this material in 6" layers to a depth of 8" above the conduit, cable, or duct. Compact to not less than 90% outside the building and 95% within the building limits of maximum density given by ASTM D698-70T (Standard Proctor Density). Owner Representative reserves the right to require soil compaction tests in any areas which do not appear to be compacted properly with the cost of the test paid by the Contractor.
   4. Replace all existing surface improvements (i.e., street pavement, curbs, sidewalks, finish sodding, etc.) removed or damaged in the course of the work unless such improvements are to be reconstructed under the general contract. Make all necessary arrangements to perform such repairs, pay all costs in connection therewith and include them in the bid.

C. Cutting and Patching:
   1. Perform all cutting and patching necessary to work, unless specifically delegated to be performed under a different Division.
   2. Obtain special permission from the Engineer before cutting structural members or finished material.

3. Perform all patching in a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the work involved. Work deemed unacceptable by Engineer will not be accepted.
4. Patch all holes left because of demolition of electrical equipment and devices.
5. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for electrical raceway. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
6. Prevent the spread of dust, debris, and other material into adjacent areas.
7. Replace all ceiling tiles damaged during installation of work, with new tile.

D. Painting:
1. Refinish all electrical equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.

E. Coordination:
1. Coordinate the location of all outlets and associated equipment with all systems before installation. Work which must be replaced due to the failure of the Contractor to verify the job conditions and coordinate with other disciplines shall be completed at no additional cost to the Owner.
2. Coordinate all door swings in the field before locating devices.
3. Coordinate all equipment dimensions before submitting equipment. This includes all shop fabricated work as well as work fabricated in place. It shall be assumed that equipment submitted has been coordinated by Contractor and the submission indicates Contractor verifies equipment will fit in allocated location space. If Contractor believes there is or finds a workspace issue, Contractor shall notify Engineer prior to submitting equipment. Replacement or modification of equipment and/or space due to lack of coordination and failure to verify existing conditions shall be completed by Contractor at no additional cost to the Owner.
4. Contractor shall be responsible for obtaining exact location of connection to equipment furnished by others, from the person furnishing the equipment.
5. If conduit, wiring or equipment cannot be installed as specified, including but not limited to installing concealed or in designed space, Contractor shall notify Engineer with ample time to review the request before Contractor purchases and/or installs such equipment. Owner and Engineer cannot and will not be held responsible for delays in project for Contractor failure to provide ample notice to review and respond to the potential issue.

3.4 FIRESTOPPING

A. Provide firestopping around all new penetrations, sleeves and openings through all partitions, walls, and floors.

B. Install firestopping on both sides of each partition, completely filling the void around the opening.

C. Firestopping of interior of conduits and sleeves is by the contractor providing the cabling inside the conduit or sleeve.

3.5 RECEIVING AND STORING EQUIPMENT

A. All equipment shall be handled and stored in accordance with the manufacturer's instructions.

B. In general, equipment packaging is not designed to protect the contents for outdoor storage. As a minimum, Contractor shall store the equipment prior to installation in a clean, dry location free from excessive temperatures, humidity, or foreign materials normally encountered at a Site. If the storage facility is unheated, Contractor shall provide heating to protect equipment from condensation, which could cause components to corrode or to be otherwise damaged.

3.6 EQUIPMENT MOUNTING

A. Unless noted otherwise, equipment which is not free-standing shall not be mounted on wood panels, but shall be attached to concrete or masonry walls, support channels, or building structural steel.

3.7 FIELD QUALITY CONTROL

A. Refer to Contract Documents for additional requirements.

B. Final Observation:
   1. A final inspection of the electrical systems will be required before the Contract can be closed out. Request a final inspection by the Engineer after all systems are fully completed and operational. The Engineer will schedule an observation and generate a list of items to be corrected or completed before Contract Closeout. If the Contractor notifies the Engineer the work is ready for final observation, final evaluation of control systems, or commissioning exercise by the Contractor, and the Engineer finds the work is not complete enough to perform that observation, the Contractor will compensate the Engineer time used. The Contractor will then perform the necessary work to complete the project and again request a Final Observation.

3.8 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, always. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean electrical equipment and remove temporary identification. In case of dispute the Owner will remove the rubbish and charge the cost to the Contractor.

B. After tests have been made and accepted clean light fixtures, panels and other equipment installed by the Contractor, leaving the entire work area in a clean and complete working order.

3.9 PROTECTION

A. Cover openings and equipment, where set, to prevent obstruction to conduits, breakage, misuse, or disfigurement of equipment. Cover openings in equipment immediately upon uncrating or receipt at the job site and keep covered until permanent connection is made.

B. Contractor is responsible for any damage to electrical equipment or materials until final acceptance of the entire project by the Owner. Keep all equipment clean materials until final acceptance of the entire project by the Owner.

C. If a portion of the project is to be occupied by the Owner prior to Substantial Completion of the entire project, make arrangements with the Owner to transfer responsibilities for protection and housekeeping.

END OF SECTION

SECTION 26 05 10 - SELECTIVE ELECTRICAL DEMOLITION

PART 1 -- GENERAL

1.1 SUMMARY

A. This Section includes all labor, material, equipment and services necessary and incidental to complete all the selective and or complete demolition and removal of electrical systems in the areas of remodeling or affected by remodeling, and the rework and extension of electrical systems indirectly affected by electrical system served “downstream” from the demolished electrical systems.

1.2 REFERENCES

A. Sections 26 05 00 and all references contained therein form a part of this Section of the Specifications.

PART 2 -- PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Demolition Drawings are diagrammatic and based on casual field observation and existing record documents. Report discrepancies to Owner Representative before disturbing existing installation.

B. Examine the building to determine actual conditions and extent of work prior to bidding the project. Refer any unclear details or conflicts to the Owner Representative for clarification prior to bidding the drawings.

C. Refer to all documents for additional demolition requirements which may be required to include in the bid.

D. Verify that field measurements and circuiting arrangements are as shown on Drawings.

E. Verify that abandoned wiring and equipment serve only abandoned facilities.

F. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Coordinate phasing of the demolition work with the construction sequence schedule.

B. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

C. Coordinate utility service outages with Utility Company.

D. Identify and provide new supporting means for existing electrical equipment such as low voltage cabling, conduits, boxes, pull boxes, conduit bodies, and conduit racks that will need additional support due to the demolition of the existing supports. This includes existing systems which are identified to require supports and become exposed when ceilings are removed.

E. Contractor shall provide new supports for all existing electrical conduit, cabling, fixtures and devices which is not supported per the requirements of the NEC and becomes uncovered due to removal of ceilings or walls.

F. Erect, and maintain temporary safeguards, including warning signs and lights and barricades for protection of the public, Owner, Contractor’s employees, and existing improvements to remain.

G. Provide temporary emergency lighting and illuminated exit signage as required by the Building Official or AHJ.

H. Electrical Service:
   1. Maintain existing system throughout construction in service until new system is complete and ready for service.
   2. Disable system only to make switchovers and connections. Notify and obtain permission from Owner Representative at least 24 hours before partially or disabling system. Minimize outage duration.
   3. Make temporary connections to maintain service in areas adjacent to work area.

I. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.

J. Conduct demolition to minimize interference with adjacent and occupied building areas.

K. Perform noisy work before or after the Owner's working hours to minimum disruption.

L. Contractor assumes responsibility if damage occurs to any and all devices to be reinstalled. If Contractor finds a damaged piece of equipment prior to demolition, Contractor shall note the equipment and notify the Owner's Representative and Engineer prior to removing the items. If Contractor does not provide the proper notification, Contractor will be held responsible for repairing or replacing the damaged equipment.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Owner reserves the right of first refusal to obtain material shown to be removed under this contract. Items not retained by the Owner become the property of the Contractor and must be removed from the premises and disposed at no additional costs to the Owner.

B. Demolish electrical systems in walls, floors, and ceilings identified to be demolished.

C. Demolish and extend existing electrical work under and this Section or as indicated on the Drawings. Remove devices, conduit, wire, boxes, and fastening devices to avoid any interference with new installation.

D. Demolish and remove all electrical systems indicated for demolition. No portion of these systems may be abandoned in place.

E. Remove, relocate, and extend existing installations to accommodate new construction or to maintain systems downstream from demolished area.

F. Provide supports for all existing electrical equipment that was supported previously by demolished walls, floors, ceiling or other structures. Provide new supports from structural members not slated for demolition, prior to any demolition.

G. Remove abandoned wiring to source of supply.

H. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit in walls, floors, or columns back to a point where patching can be adequately performed and patch surfaces.

I. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

J. Disconnect and remove abandoned panelboards and distribution equipment.

K. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

L. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.

M. Repair adjacent construction and finishes damaged during demolition and extension work.

N. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

O. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Relocate and reroute conduit and wiring as required for conduit concealed in walls or structure being altered as part of the remodeling. Maintain continuity to all devices in and downstream of remodeled work.

P. Reroute existing raceway and wiring which is exposed due to removal of existing construction. Conceal new raceway and wiring and maintain operation.

Q. If conductors are required to be removed from existing raceways, install with new conductors.

R. Provide new coverplates throughout the remodeled areas.

S. Dispose of fluorescent lamps, ballasts, and other hazardous materials in accordance with State and Federal regulations.

T. Seal all holes and openings left in smoke, sound or fire rated walls, ceilings, or floors. Completely fill with intumescent type fire rated barrier.

U. When ceilings are to be removed and ceiling devices such as luminaires, receptacles, WAP's, fire alarm equipment, security equipment, and others is indicated to be removed and reinstalled, Contractor shall remove and store the equipment offsite until the project has advanced enough and the equipment can be reinstalled. The Contractor may elect to temporarily support the devices in place, however Contractor must coordinate this with all disciplines and Contractor is responsible for removing and/or relocating the equipment as needed during the course of work.

3.4 EXISTING PANELBOARDS

A. Identify circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Reuse breakers if possible. Provide new breakers for new equipment unless breakers are specifically noted on the plans to be reused.

B. Tag unused circuits as spare and turn breakers and/or switches off.

C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding project area is not in use.

D. Remove existing wire no longer in use from panel to equipment.

E. Where existing panelboards are indicated to be demolished, extend any remaining live circuits to the nearest suitable panelboard.

F. Clean out debris, dust and dirt from existing panelboards which are modified under this project.

G. Provide updated panelboard schedules at the end of every work shift. Temporary panel schedules may be hand written and posted on or near the panelboard.

H. Provide new updated machine typed directories in every panelboard modified under this project prior to substantial completion.

3.5 CLEANING AND REPAIR

A. Prior to reinstallation of used equipment, thoroughly inspect each item and report any defects to the Owner Representative in writing. Instructions for corrective measures will be given at the time and the Contract amount adjusted accordingly. If no defects are reported, the material will be included under the contractor's one year guarantee.

B. Equipment: Clean exposed surfaces and interior. Check tightness of electrical connections.

C. Luminaries:
   1. Where existing luminaries are indicated to be re-used, remove existing luminaries for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry.
   2. Replace ballasts, lamp holders or other parts which become damaged due to work during the construction period.
   3. Provide new lamps.

D. Repair adjacent construction and finishes damaged during demolition and extension work.

3.6 INSTALLATION

A. Install relocated materials and equipment as indicated on the drawings.

END OF SECTION

SECTION 26 05 19 - CONDUCTORS AND CABLES

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes, but not limited to:
   1. Wire
   2. Multi-conductor Instrument Cable.
   3. Data cable.
   4. Fiber Optic cable.
   5. Terminals and connectors.
   6. Installation.
   7. Splices, Taps, and Terminations.
   8. Identification.

1.2 REFERENCES

A. Section 26 05 00: Common Work Results for Electrical

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 05 00.

PART 2 -- PRODUCTS

2.1 WIRE

A. All wire and cable shall be:
   1. New and coiled or on reels.
   2. Each coil and/or reel shall have a label with the manufacturer's name, trade name of wire, size of wire, and UL label.

B. Provide conductors with a 90ºC insulation system, 600-volt rating, U.L. approved and listed for specific application.

C. Feeder and Branch Circuit Wire:
   1. Stranded conductor, unless noted otherwise.
      a. Solid copper conductors shall be used for lighting and convenience receptacle circuits.
   2. THWN insulated for conductor sizes #4 AWG and smaller.
   3. XHHW or THWN insulation for conductor sizes #3 AWG and larger.

D. Provide minimum No. 14 AWG conductor size, unless noted otherwise.
      a. Wiring for power circuits shall not be less than 12AWG in size, unless noted otherwise.
      b. Unless otherwise specified elsewhere in these specifications, control wiring shall be not less than No. 14 AWG.
      c. Control wiring shall be sized such that the voltage drop under in-rush and continuous operation conditions does not adversely affect operation of the controls.

E. All conductors to be copper; aluminum conductors will not be allowed.

2.2 MULTI-CONDUCTOR INSTRUMENT CABLE

A. 2-conductor, 3-conductor, or 4-conductor as required by the process or equipment.

B. Twisted shielded cable, Aluminum foil shield and drain wire.

C. Stranded tinned copper conductors, minimum size of #16 AWG copper.

D. Polyethylene color-coded insulation.

E. Overall PVC or neoprene jacket which is resistant to oil, ozone, moisture, and sunlight.

F. Contractor shall verify cable and signal requirement with equipment manufacturer recommendations. Special instrument and signal cable shall be provided with the equipment which requires them.

2.3 DATA CABLING

A. Provide data cabling with the following minimum specifications:
   1. Provide plenum rated cable.
   2. Provide blue colored jacket for all data cabling.
   3. ANSI/EIA/TIA-568-B.2 Category 6A compliant.
   4. 23AWG size conductors.

B. Provide equipment, testing, and certification by the manufacturers of the equipment as an installed system that meets Category 6A standards for data cabling systems, including the terminations and outlet devices.

C. Approved manufacturers:
   1. Hitachi
   2. Superior-Essex
   3. CommScope/Uniprise
   4. General Cable
   5. Or equal

2.4 OPTICAL FIBER CABLING

A. Single-Mode, loose tube cable
   1. Complies with TIA/EIA-568-B.3 for color-coding.
   2. For use in indoor/outdoor/underground conduit and indoor plenums.
   3. Water-blocked cables with fungus resistant jacket and sunlight resistant per UL 444.

B. Provide fiber connector on each strand on both ends of cable. Connector type shall be per City standard.

C. Approved manufacturers:
   1. Berk-Tek
   2. Hitachi
   3. Belden
   4. Corning
   5. Superior-Essex
   6. CommScope/Uniprise
   7. Mohawk/CDT

2.5 WIRE COLOR CODING

A. Contractor may use color coding at his discretion, except for the following colors, which shall be used only as designated below for both power and control circuits.
   1. Control Circuits
      a. Dark Blue - Direct current circuits.
      b. Light Blue - Intrinsically safe conductors.
      c. Green - Grounding conductor.
      d. White - Neutral conductor.
   2. Power Circuits

	120/240V	208Y/120V	480Y/277V
Phase A	Black	Black	Brown
Phase B	Red	Red	Orange
Phase C		Blue	Yellow
Neutral	White	White	Gray

Ground	Green	Green	Green

3. Use solid colors through Size No. 8 AWG.
4. Use black conductors with tape color identification No. 6 AWG and larger.

2.6 TERMINALS AND CONNECTORS

A. Tool compressed terminals and connectors shall be made of 1 piece seamless highly conductive copper with a uniform tin-plate coating to minimize corrosion.

B. Step-down adapters shall be copper compression type.

C. Electrical spring connectors:
   1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for application used.
   2. The integral insulator shall have a skirt to completely cover the stripped conductors.

D. Electrical push-in connectors:
   1. Nylon/PC housing material.
   2. Copper contacts with tin plating.
   3. Rated for 221-degree F.
   4. 2,3 or 4 port as needed per circuit. Do not provide unused ports.
   5. Sized per wire gauge.
   6. To be used with wire gauge 12 and smaller.
   7. UL Listed.
   8. Manufacturer:
      a. Ideal
      b. Or pre-approved equal.

E. Fork Terminals:
   1. Vinyl or nylon self-insulated locking type.
   2. Terminal insulation that supports wire insulation.
   3. Manufacturer:
      a. Thomas & Betts Type FL
      b. Burndy Type TP-LF
      c. Panduit Type PNF
      d. 3M Type MNG.

F. Electrical Tape:
   1. UL Listed.
   2. Weather resistant.
   3. Moisture resistant vinyl.
   4. Rated for the voltage system which it is applied.
   5. Temperature rating suitable for the application on which it is applied.

G. Motor Connection Kit:
   1. UL Listed.
   2. Qualified to ANSI standards.
   3. Rated to withstand 1000V.
   4. For use on in-line or stub motor lead splices.
   5. Resistant to abrasion.
   6. Installed per manufacturer's recommendations.

H. Underground Splices for No. 10 AWG and Smaller:
   1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations and approved for copper and aluminum conductors.
   2. The integral insulator shall have a skirt to completely cover the stripped conductors.
   3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

I. Underground Splices for No. 8 AWG and Larger:
   1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations and approved for copper and aluminum conductors.
   2. Insulate with materials approved for the particular use, location, voltage, and temperature. The insulation level shall be not less than the insulation level of the conductors being joined.
   3. Splice and insulation shall be products of the same manufacturer.

2.7 CONDUCTOR PULLING COMPOUND

A. Rated for use with conductor insulation and conduit material.

B. Non-conductive.

C. Non-cementing.

D. Dry to a fine lubricating powder or a thin film which does not harden in conduit.

E. UL Listed.

F. Rated for repeated exposure to high heat or freezing temperatures.

2.8 CONDUCTOR IDENTIFICATION

A. Imprinted labels
   1. UL Listed.
   2. Machine typed in blank ink.

B. Label Sleeves
   1. Non-burning.
   2. Heat-shrinkable.
   3. Clear.
   4. UL Listed.

C. Self-Laminating
   1. Vinyl.
   2. Wrap around.
   3. Acrylic adhesive.
   4. Water and Oil Resistant.
   5. UL Listed
   6. Machine typed in blank ink.

D. Manufacturers:
   1. Brady
   2. 3M
   3. Raychem TMS
   4. Thomas & Betts E-Z Code

PART 3 -- EXECUTION

3.1 WIRE INSTALLATION

A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.

B. Install all conductors in a continuous raceway system.

C. Splice conductors only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.

D. Pulling compound shall be approved by the cable manufacturer.

E. Conductors of different voltage systems shall not be installed in the same raceway.

F. Examine all wires before installation. Do not use any wire with insulation that is damaged in any way.

G. Do not pull wire into the conduit until the conduit system is complete. Pull all conductors into the raceway at the same time.

H. Adequate measures shall be employed to determine that the raceways are free of foreign material and moisture before pulling wire or cable.

I. Test all cable and wire for continuity and for shorts prior to energizing any circuits.

J. Conductors shall extend at least 4" past the point of the cover on any junction or pull box installed.

K. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.

L. Conductors shall be without splice from termination to termination, unless indicated otherwise on the Drawings.

M. Provide an equipment grounding conductor with each circuit.

N. The use of a shared neutral on multiwire branch circuits will not be allowed. Each circuit shall be provided with its own neutral conductor(s), unless noted otherwise in the Contract Documents.

O. The contractor shall provide conductors with the appropriate rating and quantity for each circuit.
   1. Voltage Drop Calculations:
      a. Wire shall be sized for a voltage drop no greater than 2% measured for circuits used to feed panelboard, distribution panels, switchboards, and service equipment.
      b. Wire shall be sized for a voltage drop no greater than 3% measured from the feeder panelboard or switchgear to its point of load termination.
      c. Contractor shall provide documentation of voltage drop calculations upon request of Engineer or Owner.
   2. Where multiple conductors are used in a shared raceway, conductor ratings shall be derated per the NEC.
   3. Where conductor sizes are specified in the Contract Documents, these sizes are based on copper conductors.

P. All analog control circuits, i.e. 4-20mA signal circuits, shall be multi-conductor instrument cable.

3.2 SPLICES, TAPS AND TERMINATIONS

A. Splices to feeders and service entrance conductors are not permitted unless specifically noted on the plans.

B. Electrical spring connectors shall be used for splices and taps in lighting and 120-volt receptacle circuits and motor leads #10AWG or smaller.

C. Use pressure or compression type connectors for all splices or taps in copper conductors.

D. Do not splice conductors of dissimilar metals together.

3.3 DATA CABLING INSTALLATION

A. Provide cabling from each data location to the technology headend equipment.

B. Number of cables:
   1. Provide a cable for each number of ports.

C. The Contractor shall provide cabling from the wall outlet to the head end location without splice.

D. The Contractor shall identify each cable end to which unit the cable is from.

3.4 OPTICAL FIBER CABLE TESTING

A. Use test equipment manufactured by Siecor, Tektronics or pre-approved equal to perform the optical fiber cable testing. The testing contractor will be trained by the test equipment manufacturer or by the manufacturer's certified representative.

B. Prior to installation, perform a visual continuity test of each strand of each cable on the cable reels to determine whether or not the cables were damaged during shipment.

C. After the cables are installed and terminated, test each strand of each fiber optic cable using an Optical Time Domain Reflectometer (OTDR) and an insertion loss tester. Perform the tests will all connectors installed and terminated. Include an original hard copy output for each strand tested, as generated by the test equipment.

D. Provide the following test results for the OTDR testing:
   1. Total cable length.
   2. Attenuation vs. cable length output graph.
   3. Splice/connector locations.
   4. If the slope of the attenuation vs. cable length at any point on the curve any strand exceeds 3.75 dB/km @ 850nm, replace the cable and retest.
   5. Include OTDR test results in the O&M manuals and the cable management software program.

E. Perform an insertion loss test for each strand of each optical fiber cable. Perform the test will all connectors installed and terminated.
   1. If the attenuation of the pair of connectors for each strand of fiber optic cable exceeds 0.5 dB per connector (1.0 dB total per strand), replace the connectors and retest.
   2. Include the insertion loss test results in the O&M manuals and the cable management software program.

3.5 IDENTIFICATION

A. Control circuits may be color-coded using available colors, except gray and green. They shall be identified at each terminal at the respective control panel with a label. Imprinted labels shall be protected by a heat shrinkable sleeve.

B. Each control circuit shall be identified at both ends with the same number; the wire number shall be the same as the wire number shown on the Contractor's Equipment Drawings. Spare conductors shall also be identified.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. Grounding Electrode System

B. Equipment grounding

C. Transformer grounding.

D. Bonding of new building additions

PART 2 -- EQUIPMENT

2.1 GROUND RODS

A. Grounding Electrode System:
   1. Provide ¾" x 10' long solid copper electrodes, where ground rods are specified.

B. Luminaire Concrete Bases:
   1. ¾" x 15' long copper weld, unless noted otherwise.

2.2 GROUNDING CONNECTORS

A. Clamps and pressure connectors.
   1. Clamps for connection to piping and conduit:
      a. Approved Manufacturer:
         1) OZ Gedney type ABG
         2) Burndy "Hyground"
         3) Thomas & Betts "Blackburn" Series.
   2. Clamps for connection to enclosures and bus work:
      a. Approved Manufacturer:
         1) OZ Gedney type KGM
         2) Burndy "Hyground"
         3) Thomas & Betts "Blackburn" Series.
   3. Bar taps for connection to bus bars which are UL listed (UL-467).
      a. Approved Manufacturer:
         1) OZ Gedney type KGM
         2) Burndy "Hyground"
         3) Thomas & Betts "Blackburn" Series.

B. Welded connections using non-reversable exothermic process:
   1. Approved Manufacturer:
      a. Cadweld
      b. Thermoweld.

2.3 WALL-MOUNTED GROUND BUSS BAR

A. Copper plate.

B. Minimum dimensions are 2" x 1/4" x 12", unless noted otherwise.

C. Manufacturer predrilled holes, minimum of 16, unless noted otherwise.

D. Wall mounting brackets with buss isolators.

E. Buss bar shall be approved by Owner's voice/data service provider(s). Contractor shall coordinate equipment with the service provider and provide quantity of holes and accessory equipment as required by the service provider.

F. Approved Manufacturer:
   1. Hutton

2. Alltec
3. Or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Raceways provided for grounding electrode conductors shall be rigid nonmetallic.

B. The conductor shall be connected to the equipment ground bus or to the enclosure if there is no ground bus.

C. Separately derived systems shall be grounded in accordance with NFPA 70.

D. The grounding bushings on conduits entering distribution equipment shall be connected to the ground bus in accordance with the requirements of NFPA 70.

E. All conductors used for grounding electrode bonding, equipotential bonding and between wall mounted grounding buses shall be copper.

3.2 GROUNDING ELECTRODE SYSTEM

A. Contractor shall provide a grounding electrode system as required per NFPA 70 in addition to items noted in the Contract Documents.

B. New Construction
   1. Provide a #3/0 concrete-encased electrode installed within the foundation of the building, tied to the steel reinforcing, in accordance with the NEC.
   2. Bond all the following building members (if present) together to form the grounding system for the building:
      a. All metal underground water pipes
      b. Metal frame of the building or structure
      c. Concrete-encased conductor identified in item 1 above.
      d. Other local metal underground systems or structures such as piping systems, underground tanks, and underground metal well casings that are not bonded to metal water piping.

C. Existing Construction (as allowed by the NEC):
   1. Provide a #3/0 conductor bonded to the metal underground water pipe. If metal water pipe is not present, drive a system of rod electrodes in order to satisfy the NEC requirements including Articles 250.53 and 250.56.
   2. Bond all the following building members (if present) together to form the grounding system for the building:
      a. All metal underground water pipes
      b. Metal frame of the building or structure

D. Bond the neutral bus to the grounding electrode system at the service entrance switchboard.

3.3 EQUIPMENT GROUND

A. Solidly ground all conduit systems, switch boxes, cabinets, motor frames, switchgear, transformers, and all other permanently installed equipment to form a continuous, permanent, and effective grounding system. Bond expansion joints and metal raceway sections.

B. An equipment grounding conductor shall be installed with each conduit run or cable, includes but not limited to feeder circuits, motor circuits, lighting circuits, and control circuits.

3.4 BONDING

A. Bond all systems per the NEC including raceway, cable tray, enclosures, metal piping systems, structural metal, and other items identified in the Contract Documents or the National Electrical Code.

3.5 WALL-MOUNTED GROUND BUSS BAR

A. Each ground buss bar shall be connected directly to the grounding electrode system with a #6 AWG conductor.

B. A wall mounted ground buss bar shall be provided at the following locations:
   1. Where indicated on the drawings.

C. Contractor shall coordinate the location of each busbar with the Owner and their technology system providers before installation.

3.6 TRANSFORMER GROUNDING

A. Provide a grounding electrode conductor routed from the wye-connected secondary of the transformer (bonded to the metal enclosure) to the nearest grounding electrode:

B. Ground each transformer to the nearest grounding electrode per the NEC:
   1. Provide the neutral to ground bonding jumper at the transformer location (at the separately derived system). Verify that the neutral to grounding bond is in place prior to energizing any electronic grade TVSS panelboards.
   2. Provide grounding electrode conductor from the bonding jumper location to the grounding electrode, minimum conductor size per the NEC.
   3. The grounding electrode conductor is defined as the nearest one of the following:
      a. Effectively grounded building steel.
      b. Effectively grounded metal water pipe at the service entrance to the building.
      c. If “a” and “b” above are not available, then provide one of the following grounding electrodes:
         1) A concrete-encased electrode tied to the building footing steel reinforcing bars.
         2) Ground rod electrode.
   4. Driving a ground rod at the transformer location is not approved unless it is installed solely as a supplementary grounding electrode to one of the approved methods listed above.

3.7 SPECIAL REQUIREMENTS

A. The contractor shall determine if there are any other special grounding requirements for equipment furnished on this Project and shall provide grounding as recommended by the manufacturer.

3.8 SPLICES AND TERMINATIONS

A. In general, splices and terminations of the grounding electrode system shall be brazed, shall be exothermic welded, or shall be made with tool-compressed fittings.

B. Connections to bus bars or equipment enclosures shall be made with tool-compressed lugs which are bolted to the equipment or with bar taps.

C. Provide a #1/0 AWG (minimum) grounding conductor from each ground bar to electrical service grounding electrode.

D. Connections to ground rods shall be exothermic welded. Provide adapter sleeves as required for #6 AWG conductors or smaller.

E. Connections to copper water piping shall be made with ground clamps.

3.9 ADDITIONS TO EXISTING BUILDING

A. Bond any new additions to the existing building’s grounding electrode system to ensure effective grounding for the entire building. Use #3/0 conductor, minimum.

END OF SECTION

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SECTION 26 05 29 - SUPPORTING DEVICES

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. Manufactured Supporting Devices.

B. Fabricated Supporting Devices.

C. Installation.

1.2 DESCRIPTION OF WORK

A. Type of support hardware, anchors, sleeves, and seals specified in this section include the following:
   1. Clevis hangers
   2. Riser clamps
   3. C-clamps
   4. I-beam clamps
   5. One-hole conduit straps
   6. Two-hole conduit straps
   7. Round steel rods
   8. Expansion anchors
   9. Toggle bolts
   10. Wall and floor seals

B. Supports, anchors and sleeves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 26 sections.

1.3 QUALITY ASSURANCE

A. Provide supporting devices, of types, sizes, and ratings required that are manufactured by firms regularly engaged in the manufacture of such devices.

B. Comply with NEC as applicable to construction and installation of electrical supporting devices.

C. Comply with applicable requirements of ANSI/NEMA std Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies".

D. Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports and equipment mounting.

E. Provide electrical components which are UL-listed and labeled.

PART 2 -- PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of device meets indicated requirements, selection is Installers' option.

B. Provide supports and anchors constructed of stainless steel, PVC or equivalent corrosion resistant material in chemical storage rooms.

C. Structural flat surfaces:
   1. Caddy snap close clamp with z shot-fire bracket; mechanical fastener appropriate for deck type; spring steel, snap close conduit opening, static load of 100lbs or greater;
      a. Conduit Sizes: ½” – 1”
   2. Caddy bolt close clamp with z shot-fire bracket; mechanical fastener appropriate for deck type; spring steel, conduit strap with threaded openings and hex-head bolt, static load of 100lbs or greater;

a. Conduit Sizes: ½” – 1”
3. One-hole conduit straps for supporting metal conduit; galvanized steel:
a. Conduit sizes: ½” & ¾”
4. Two-hole conduit straps for supporting metal conduit; galvanized steel:
a. Conduit sizes: 1” and larger.

D. Beam flange:
1. Caddy clip for supporting conduit to beam flanges; spring steel, snap close conduit opening, static load of 75lbs or greater;
a. Conduit sizes: 1/2" & 3/4"
2. Beam Clamp; steel; mechanical bolt fastener to beam; conduit strap with threaded holes and hex-head bolt.
a. Conduit sizes: 1/2" – 2”
3. Right angle conduit clamp: cast iron hot dipped galvanized; U-bolt with treaded ends and hex-head nuts.
a. Conduit sizes: 2” – 4”
4. One-hole conduit straps for supporting metal conduit; galvanized steel:
a. Conduit sizes: ½” & ¾”
5. Two-hole conduit straps for supporting metal conduit; galvanized steel:
a. Conduit sizes: 1” and larger.

E. Rod Type Hangers:
1. Clevis type hangers; galvanized steel; with diameter hole for round steel rod.
2. Rods galvanized steel; hexagon nuts on both ends of rod:
a. Conduit size 1/2"-1.5”: Minimum rod size 3/8”.
b. Conduit size 2” to 3.5”: Minimum rod size 1/2".
c. Conduit size 4”-5”: Minimum rod size 5/8”.
3. C-clamps for supporting rods to beam flanges; mechanical bolt fastener.

F. Provide anchors of types, sizes and materials indicated; and having the following construction features:
1. Expansion Anchors: 1/2".
2. Toggle Bolts: Springhead; 3/16" x 4".

G. Provide sleeves and seals, of types, sizes, and material indicated; having the following construction features:
1. Provide Schedule 40 galvanized steel pipe sleeves 1 1/2" larger than O.D. of pipe.
2. Set all sleeves true to line, grade and position and plumb or level after concrete is poured. Correct any deviation from proper position.
3. Provide minimum of three (3) concrete anchors for Schedule 40 pipe sleeves.
4. Provide factory-assembled wall and floor seals. Provide watertight seals around conduit, pipe, or tubing passing through concrete below grad floors and wall. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
5. Caulk spaces between pipe and floor sleeves inside the building with a waterproof caulking material. Caulk spaces between pipe and exterior partition sleeves with glass fiber insulation.
6. Furnish sealable penetration pockets compatible with the building roofing system where conduits pass through the roof. Turn pockets over to the General Contractor.
7. Provide fire barriers around conduit, pipe, tubing, bus ducts and cables passing through smoke and fire rated floors and walls. Provide CP 25, 303 and PSS7904 Series by 3M, or "Flame-Safe" system by Thomas and Betts Corp for fire seals.
8. Subject to compliance with requirements, provide water-tight seals by Thunderline or pre-approved equal.

H. Provide channel strut system for supporting electrical equipment, 16-gage hot dip galvanized steel, or types and sizes indicated; construct with 9/16" dia. holes, 8"o.c. on top surface, with standard green finish, and with the following fittings which mate and match with channel provided:
1. Fixture hangers

2. Channel hangers
3. End caps
4. Beam Clamps
5. Wiring stud
6. Thin wall conduit clamps
7. Rigid conduit clamps
8. Conduit hangers
9. U-bolts

I. Roof supports
1. Cooper B-Line Dura-Blok or equal.

2.2 FABRICATED SUPPORTING DEVICES:

A. Provide sleeves of one of the following:
1. Sheet-metal fabricated from galvanized sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gages: 3" and smaller, 20 gage; 4" to 6", 16 gage; over 6", 14 gage. Sheet metal sleeves shall not be used for cable.
2. Steel-Pipe fabricated from Schedule 40 galvanized steel pipe; remove burrs.
3. Iron-Pipe fabricated from cast-iron or ductile-iron pipe; remove burrs.

B. Provide fire barrier sleeve seals for sleeves located in floor and firewalls. Provide approved fire barrier material.

PART 3 -- EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hanger, anchors and sleeves in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements of NECA, NEC and ANSI/NEMA. Extend sleeves 3/4" above floor surface.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Support suspended conduit runs threaded rod and galvanized conduit hangers. Attach the hanger rod to concrete structural members with malleable iron inserts, to existing or precast concrete structural members with self-drilling anchors, to structural steel with steel "C" clamps, and to wood with suitable sized lag screws and angles. Support multiple parallel conduit runs on trapeze hangers constructed of steel rod hangers and structural channel. Include three (3) nuts jam-locked, on all threaded rod hangers, to rigidly support the conduit. Install supports with maximum spacings indicated.

D. Support surface mounted conduit runs with galvanized pipe straps. Fasten pipe straps to masonry surfaces with self-drilling anchors or toggle bolts. Fasten pipe straps to wood or sheet metal surfaces with pan head sheet metal screws.

E. Support wall mounted electrical equipment on 3/4" thick C-D exterior fir plywood painted with two (2) coats of ASA-49 gray enamel.

F. Provide stainless steel screws where electrical equipment is mounted on or attached to fire treated plywood. Hold equipment away from the plywood with either plastic or stainless-steel washers or spacers.

G. Support all ceiling mounted receptacles with a listed tile bridge spanning the suspended ceiling grid, plus a 1/4" threaded rod anchored to a structurally sound member directly above the outlet box.

H. Tighten sleeve seal nuts until sealing grommet have expanded to form water-tight seal.

I. Provide finish of supporting devices in the chemical storage room as follows:
1. Provide PVC-coated galvanized concrete inserts and pipe straps.
2. Provide stainless steel for all bolts, nuts, washers, and screws.

3. Provide PVC-coated individual hangers and trapeze hangers.
4. Provide individual galvanized rods with two (2) coats of epoxy paints.

3.2 LIGHT FIXTURE SUPPORTS

A. Securely support all light fixtures directly from building structural members or 1-1/2" or larger steel ceiling framing channels. Use steel channel where it is necessary to span the building structural members for equipment support.
   1. Wood supporting members or wires will not be acceptable.
   2. Provide minimum ¼" diameter lag screws when anchoring into wood structural members. Penetrate wood structural members a minimum of 2" with all screws.
   3. Provide steel expandable type, anchors with minimum penetration of 1-1/2" when anchoring to concrete.
   4. Do not suspend any conduit, light fixtures, or ballasts from metal roof deck or from the ceiling suspension wires. Support all lay-in fixtures independent of the ceiling support system.
      a. In lay-in ceilings provide fastening clips on each corner of each fixture.
      b. Where fixture suspension wires are required, wires shall be fastened to a structural member directly above or no greater than a 5-degree angle from the light fixture corner of which it is fastened to.
      c. Fixture suspension wires shall be provided so that fixture is not allowed to drop more than 1" if ceiling would happen to collapse.

B. Equip all fixtures using conduit stems with ball swivel hangers. In finished areas, provide canopies for the hangers.

C. Support all surface mounted fixtures with a minimum of one hanger per fixture plus one per row. Support individual fixtures with a minimum of two hangers. Attach fixture hangers to the ceiling grid per code.

D. Support all suspended fixtures with a minimum of two fixture hangers. Attach each hangar to a dedicated anchor. Locate hangars directly above the corners of the light fixtures.

3.3 ROOF SUPPORT FOR CONDUIT RACKS

A. Roof mounted conduits are to be avoided where at all possible. Contractor shall coordinate proposed roof mounted conduit routes with Engineer to verify other routes are not feasible prior to installation.

B. Provide Dura-Blok rooftop supports at a minimum of 10'o.c. or per manufacturer's recommendations.

END OF SECTION

SECTION 26 05 33 - RACEWAYS, FITTINGS, AND BOXES

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes
1. Conduit.
2. Conduit fittings.
3. Conduit accessories
4. Underground warning tape.
5. Pull and junction boxes.
6. Fire stop material.
7. Handholes.
8. Conduit Identification.
9. Execution/Installation.

1.2 REFERENCES

A. Section 07 84 00: Firestopping.

B. Section 26 05 00: Common Work Results for Electrical

C. Section 33 05 05: Trenching and Backfilling.

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 05 00 in addition to the requirements of this section.

PART 2 -- PRODUCTS

2.1 STEEL RIGID METAL CONDUIT (RMC) AND FITTINGS.

A. Provide hot-dip galvanized or electro-galvanized (inside and outside) conduit having a bichromate finish conforming to UL standard UL-6.

B. Provide zinc coated, threaded type fittings, couplings, and bushings.

2.2 ALUMINUM RIGID METAL CONDUIT (RMC) AND FITTINGS.

A. Provide conduit conforming to U.L. Standard UL-6 with the inside coating of wax or similar coating to facilitate pulling.

B. Provide thread type fittings, couplings, and bushings.

2.3 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS.

A. Provide hot-dip galvanized steel conduit conforming to UL Standard 1242 and Federal Specification WW-C-581E.

B. Provide zinc coated, threaded type fittings, couplings, and bushings.

2.4 RIGID NON-METALLIC CONDUIT (RNMC) AND FITTINGS.

A. Schedule 40/80 polyvinyl chloride (PVC) rigid plastic conduit conforming to NEMA Specifications TC-2.

B. Provide plastic fittings, couplings, and bushings per manufacturer's recommendations for rigid non-metallic conduit, designed for use with solvent cement.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) AND FITTINGS.

A. Metallic conduit covered with an extruded, polyvinyl chloride sheath.

B. Provide steel or malleable iron, water-tight type fittings, couplings, and bushings approved for use with liquid-tight flexible metal conduit. Cast type devices are not acceptable.

2.6 HAZARDOUS LOCATION FLEXIBLE CONDUIT/FITTINGS

A. Flexible conduit system comprised of metallic braid.

B. No bonding jumpers required.

C. Manufacturer installed connections/fittings at both ends.

D. Stainless Steel

E. Rated for Class 1, Division 1 and II, Group D locations.

F. Manufacturer:
   1. Crouse-Hinds EC series.
   2. Or Equal.

2.7 OUTLET AND JUNCTION BOXES

A. Provide galvanized code gauge metal outlet and junction boxes with screw-on covers of type, shape and size listed for each application.

B. Provide gasketed covers in damp and dusty locations, and where required to meet the listed use (i.e. wet locations).

C. Provide cast metal boxes (FS and FD) for all locations where IMC and RMC are required under Section 26 05 33.

D. Provide 4" square minimum trade size square boxes for all outlet and junction boxes. Provide appropriate mud rings, tile rings or raised covers, depending on the application and allowable installation.

E. Provide 3½” deep boxes when installed in masonry, including precast construction. Provide 2⅛” minimum deep boxes when installed in non-masonry locations. Shallower boxes (1½”, 1¼”) are allowed only at locations where the wall cavity depth does not permit deeper boxes to be installed concealed within the wall.

F. Refer to other sections for additional outlet box requirements specific to other systems.

G. Provide boxes with the appropriate size and quantity of conduit knock outs. Knock outs may be pulled or reamed out to larger sizes on most steel boxes.

H. Approved steel box manufacturers:
   1. Raco
   2. Steel City
   3. Pre-approved equal

I. Approved cast metal box manufacturers
   1. Appleton
   2. Crouse-Hinds
   3. Killark
   4. Bell
   5. Red Dot
   6. Pre-approved equal.

J. Chemical Rooms:
   1. Boxes in chemical rooms shall be non-metallic FS or FD boxes.
   2. Weatherproof die-cast aluminum boxes with threaded outlets for all surface mounted outlets; Bell (Raco) or approved equal.

2.8 INTERIOR PULLBOXES

A. Provide listed metal boxes with removeable screw-on covers.

B. Boxes with a dimension larger than 12” shall have a cover attached with hinges and stainless-steel screws located within 1/2 inch of each corner opposite the hinges and spaced not more than 12 inches apart.

C. Size boxes to adhere to the NEC.

D. Provide enclosures that have a NEMA rating that meet or exceed the environment in which they are installed.

E. Approved manufacturers:
   1. Hoffman Enclosures
   2. Electro Mechanical Industries (EMI)
   3. American Midwest Power (AMP)
   4. Pre-approved equal.

2.9 EXPLOSION PROOF BOXES

A. Copper-free aluminum with threaded covers, mounting lugs, and drilled and tapped conduit openings.

B. Dome covers if space required.

C. UL listed for area classification.

D. Approved Manufacturers:
   1. Appleton GUB or GUBD
   2. Crouse-Hinds GUB,
   3. Killark.
   4. Approved Equal.

2.10 UNDERGROUND WARNING TAPE

A. 6 inches wide, 4-mil polyethylene film.

B. Vivid, opaque, long-lasting red color with bold, black letters.

C. Lettering
   1. Top line – “...CAUTION CAUTION CAUTION...”
   2. Bottom line – “...ELECTRIC LINE BURIED BELOW...”

D. Approved Manufacturers:
   1. Seton Name Plate Corp. No. 210 ELE, EMED Co. Stock No. UT27737-6
   2. Approved Equal.

2.11 FIRE RETARDANT MATERIAL

A. Fire stop foam.

B. Fire stop sealant.

C. 3-hour fire rating.

D. UL Classified per UL-1479.

E. Chase Technology Corp., Dow Corning, General Electric, 3M, or equal.

2.12 ALUMINUM THREAD COMPOUND

A. Antioxidant and anti-seize compounds.

B. Burndy Penetrox, Ideal NOALOX, Ilsco DE-OX, or equal.

2.13 DUCT SEALING COMPOUND

A. Soft, fibrous, slightly tacky, non-hardening, and easily applied by hand at all working temperatures.

B. Clean and non-staining.

C. J.M. Clipper Corp. Duxseal, O-Z/Gedney DUX, or equal.

2.14 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.
   3. For Class 1 Division 1 or Division 2 hazardous location boundaries, conduits shall be sealed at the point where they leave the room. Fittings shall be "EYS," Appleton or Chico "X" Fiberdam and Apelco or Chico "A" compound or approved equal.

2.15 CONDUIT IDENTIFICATION

A. 3/4 Inch By 3-1/2 Inches
   1. Nylon plates.
   2. Marked in black with a marking pen specifically designed for such use.
   3. Manufacturer: Panduit MP350, or equal.

B. 2-3/8 Inches By 4-3/4 Inches
   1. Medium weight shipping tags with reinforced eyelet.
   2. Marked in black with a marking pen specifically designed for such use.
   3. Manufacturer: Dennison Size 5, Grade G, or equal

C. Tag Protection
   1. Adhesive-backed plastic or clear polyester film tape.
   2. Manufacturer: 3M Scotch Brand 3750 Clear Box Sealing Tape, or equal.

PART 3 -- EXECUTION

3.1 CONDUIT SIZES

A. Verify conduit sizes indicated on the Contract Documents prior to installation. Provide proper size conduit based on the NEC maximum fill requirements, including any derating factors. Where conduit sizes are indicated on the plans, it is a minimum size allowed. It is the Contractor’s responsibility to provide the proper conduit size, including any grounding conductors and flexible connections to equipment.

B. Where conduit sizes are not shown, provide conduit with the minimum sizes:
   1. 1.25” conduit for underground
   2. 3/4” conduit size everywhere else

C. Spare conduits shall be sized as noted in the Contract Documents. Where spare conduit sizes are not identified provide a minimum size of 1.25”.

3.2 INSTALLATION

A. Installation of conduit shall meet the requirements of the NEC and the National Electrical Contractors Association (NECA) conduit installation standards. Where the documents may conflict, the requirements of the NEC take precedence.

B. Install all conductors in a continuous raceway system.

C. Circuits of different voltage systems shall be installed in separate raceways, unless specifically noted otherwise in the Contract Documents.

D. Provide pull and junction boxes as required by the NEC and as site pulling requirements dictate.

E. Conduits entering boxes and equipment from a flat surface shall be provided with an offset 3” from the box to allow the conduit to be fastened securely to the flat surface it is run on.

F. Do not route any conduits across rooftops, unless specifically allowed and noted on the plans to do so. Where conduits are allowed to be routed across rooftops, install conductors in Rigid Metal Conduit and provide proper derating of the conductor ampacities to account for the high ambient temperature as required in NEC. Mount conduit on roof blocks specifically designed for the intended environment.

G. Support all trapezes and all above-ground conduits from the building structure.

H. Route all horizontal raceway above water piping, where possible.

I. Do not support conduit with wire, nylon ties, nor perforated pipe straps. Remove wire used for temporary support.

J. Do not attach conduit to ceiling support wires.

K. Run all exposed conduit in a neat, workmanlike manner parallel to the building lines, tight to the wall and ceiling surfaces, and firmly support with conduit clamps or hangers.

L. Do not run conduits in the following:
   1. Columns except feed column mounted devices.
   2. Through structural slabs, beams, or columns, unless approved by the Structural Engineer.
   3. Concrete topping.
   4. Through the same penetrations through floors and walls as mechanical piping unless noted otherwise or if approved by the Engineer.

M. Place conduits at least 8" away from all hot piping and surfaces including domestic hot water lines.
   1. Boxes shall be a minimum of 3” from any process pipes, unless noted otherwise.

N. Do not mount conduit on mechanical equipment except where necessary to connect electrical devices mounted on the equipment. Provide flexible conduit in all runs "bridging" vibration mountings.

O. Do not run conduit on or directly in front of access doors, removable panels, equipment removal spaces, control devices or other spaces necessary for normal maintenance and repair of the equipment.

P. Install all exterior underground branch circuit conduits continuously from the source to the load. Do not install in-ground boxes as pull boxes. Oversize the conduits if required.

Q. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system. Install exterior underground conduits to drain away from the building.

R. Provide suitable fittings to accommodate expansion, contraction, and deflection where conduits cross seismic, control and expansion joints. Avoid crossing expansion joints where possible.

S. Cap or plug conduit ends during construction. Cap or plug ends of conduit that are to remain empty and make watertight. Clean and swab conduits prior to pulling in conductors.

T. Provide nylon pull string in all empty conduit with a stamped plastic label indicating future use.

U. Where conduits are stubbed out above walls for use of future or low voltage cabling, provide a bushing on the end of the conduit to protect cabling.

V. Expansion fittings shall be installed at building expansion joints and where the length of straight run requires it.

W. Aluminum Conduit:
   1. Aluminum conduit shall not be installed in direct contact with concrete. When installed on concrete surfaces, provide a metal framing channel mounting bracket to secure the aluminum conduit to the surface.
   2. Do not use conduit bushings to secure threaded aluminum RMC to a box or enclosure. Install a locknut between a conduit bushing and the inside of the box or enclosure.

X. Underground Conduit:
   1. Underground conduit runs shall have a minimum cover of 2 feet.
   2. Conduit shall be sloped to drain to handholes or pull boxes.
   3. Rigid metal conduit shall be used for the vertical elbow and riser out of the ground.
   4. Rigid metal conduit installed underground or passes through concrete shall have a corrosion resistant coating or covering at the points it contacts earth and/or concrete.
   5. Contractor shall do all trenching for underground conduit with a minimum size trench. 3 inches of sand shall be placed below and above buried conduit in trench. All fill material shall be placed in 12-inch lifts and compacted to 90-Percent Standard Proctor Density. Underground warning tape shall be laid in the trench approximately 9 inches below the surface.
   6. The roadway, sidewalk, or grade beneath which conduit is routed shall be restored to its original or better condition.
      a. Provide grading, soil, and seeding or sod to restore turf to original or better conditions.
      b. Coordinate type of soil, seeding and/or sod with Owner to match existing.
   7. Excavating, backfilling, and grading shall comply with Division 31.

Y. Conduit installed in slabs shall conform to the following requirements:
   1. Conduit shall not be tied parallel to reinforcement bars.
   2. Conduit must not be tied to each other and shall be spaced a minimum of 1 1/2 inches apart and preferably 3 inches apart.
   3. Whenever possible, conduit should not cross over other conduit. All crossing conduits must be reviewed and approved by the Engineer prior to placement of concrete.
   4. Conduit must not be placed on top of the bottom mat of reinforcement bars. There should be a minimum of 1 inch separation from the bottom of the conduit to the top of the steel bars in the bottom mat of steel.
   5. Prior to placement of the conduit, the contractor must submit an appurtenance embedment drawing that shows the proposed locations of all conduits.

Z. Conduit and Penetration Sealing:
   1. Seal all conduits where they pass through exterior walls and where they enter exterior fixtures.
   2. Seal all conduits where temperature differential between adjacent spaces is greater than 30 degrees Fahrenheit.
   3. Seal all conduit penetrations of smoke or fire rated walls or floors with intumescent type fire barriers.
   4. All conduits leaving the chemical handling rooms and other areas designated on the Drawings shall be sealed internally with duct sealing compound at the point where they leave the room.
   5. All conduits leaving any hazardous locations shall be sealed internally at the point where they leave the room.

3.3 HAZARDOUS AREAS

A. Install all conduit and raceways located in hazardous areas in accordance with National Electrical Code requirements for that classification of hazardous locations. Provide all fittings and equipment approved by the Underwriter's for this type of location.

B. Where it is necessary to install sealing fittings accessible from rooms or areas which are finished, a flush wall or ceiling outlet box is to be installed and the conduit to be sealed run straight through the box with the sealing fitting occurring within the outlet box. Cover the box with a blank plate.

C. Conduit fittings installed in Class 1, Division 1 and Class 1, Division 2 locations shall be rated for Class 1, Division 1 locations, unless noted otherwise.

D. Boxes installed in Class 1, Division 1 and Class 1, Division 2 locations shall be rated for Class 1, Division 1 locations, unless noted otherwise.

3.4 OUTLET AND JUNCTION BOX INSTALLATION

A. Maintain accessibility to all outlet and junction boxes as required by the NEC.

B. The mounting heights indicated on the drawings are from the center of the outlet box to the finished floor directly below the outlet. Exterior heights are from inside adjacent door, or if no door, from the first floor above grade, unless noted otherwise.

C. Coordinate the location of all outlets with all drawings before installation. Verify mounting heights and locations of all outlet boxes, including the following:
   1. Coordinate device locations with the Owner's final furniture plan(s) before rough-ins. It is advised for the Contractor get a final signed document stating this coordination was performed.
   2. Outlets are located on walls with baseboard radiation. Mount to the side of radiation covers.
   3. Switch boxes at doors. Verify door swings. Install switchboxes on the latch side of the door if possible.
   4. Outlet boxes at casework. Mount outlet boxes above counters and above backsplashes.
   5. Outlet boxes at undercounter refrigerators. Mount outlet boxes in the space reserved for the refrigerator.
   6. Outlet boxes for microwave units. Mount outlet boxes in the space reserved for the microwave.
   7. Outlet boxes adjacent to marker boards or other wall-hung items. Verify top edge and bottom edge of wall-hung items and mount outlets on clear wall space.

D. Do not mount boxes back-to-back or nippled together.
   1. Boxes mounted on opposite sides of a wall shall be mounted on separate studs.

E. Do not use through-wall boxes unless specifically called out on the plans.

F. Field-gangable boxes are not allowed. Provide manufactured, multi-gang boxes.

G. Provide separate switch boxes for lighting dimmer switches to maintain full dimmer rating, if derated wattage/ampere is below the designated circuit ampacity.

H. Close openings in all outlet boxes during plaster and concrete work with plain paper or slip-on plastic or metal plates.

I. Provide knockout closures to cap used knockout holes.

J. Provide FS and FD boxes in wet, damp, and exterior locations.

K. Maintain vapor barriers around boxes and/or provide suitable boxes listed for use in vapor barriers.

L. Provide air-tight seals for all boxes in air plenums that can allow air to pass through connecting conduit. Repair all damage to insulation and vapor barriers.

M. Where boxes and concrete are installed in masonry, provide listed equipment or the means acceptable to the AHJ necessary to provide concrete-tight connections and boxes required by the NEC.

N. Where receptacle and voice/data or TV boxes are to be provided accessible on the same side of a wall or surface, they shall be provided on the same stud or within 4" of each other.

3.5 INTERIOR PULLBOX INSTALLATION

A. Provide concealed pull boxes in all new construction, except mechanical and electrical rooms. Pull boxes in mechanical and electrical rooms may be installed exposed.

B. Terminate all conduits at cabinets and boxes with locknuts and bushings. Provide insulating bushings on all conduit 1" and larger.

C. Provide pull boxes in accessible locations. Provide accessibility to the pull box cover. Coordinate location of pull/junction boxes with other divisions (trades) prior to installation. Do not locate pull boxes in exposed finished spaces without the specific approval of the Owner Representative.

D. Provide ½" clear space behind boxes when mounting in wet or damp locations.

3.6 EXTERIOR IN-GROUND HANDHOLES

A. Reference NEC for handhole requirements and installation.

B. All handholes shall have a drain opening in bottom. Excavating handholes shall be dug at least 24 inches deeper than the depth of the bottom of the handhole and the area below the handhole shall be filled with pea gravel.

C. Handhole covers shall be bolted in place when Work is complete.

3.7 CONDUIT BODY INSTALLATION

A. Provide conduit bodies in accessible locations. Provide accessibility to the cover. Coordinate location of conduit bodies with other divisions (trades) prior to installation. Do not locate conduit bodies in exposed finished spaces without the specific approval of the Owner Representative.

3.8 OPENINGS

A. Contractor shall review the size and location of all openings to be sure they meet the requirements of the equipment that is furnished and/or installed as a part of this Contract. The contractor shall be responsible for providing all required openings necessary for a complete installation. All required openings are not shown on the Drawings.

B. All openings shall be filled with an approved sealant, caulking, or grout after the conduit or cable installation is complete.

C. Openings through grating shall have the bars of the grating banded.

D. Special care shall be taken to make a gas-tight seal around all conduits, capillary tubes for remote bulb thermostats, etc. which enter chemical handling rooms, hazardous areas, and other areas designated on the Drawings.

E. Provide watertight seal around conduit in openings which are approved by the Owner Representative, for all roof, below grade and exterior wall penetrations.

F. Provide airtight seals for all raceway penetrating air plenums. Repair all damage to insulation and vapor barriers. Seal vapor barriers tight to conduit penetrating vapor barriers.

3.9 IDENTIFICATION

A. Provide panel and circuit number(s) identification on the cover of all junction boxes and pull boxes located in accessible areas (i.e. above accessible ceilings).

B. Provide clear, hand-printed lettering using a black permanent marker.

C. Perform stenciling after the building has been painted so that overspray from building painting does not cover up stenciling performed under this specification section. Re-label any boxes that have been painted over by the painter.

D. Conduit containing control cabling/wiring which utilize Intrinsically Safe methods shall be identified with permanently affixed labels with the wording “Intrinsic Safe Wiring.”

3.10 RACEWAY AND BOXES APPLICATIONS

A. All conduit may be installed exposed, except were designated to be installed underground.

B. Outdoors (non-corrosive):
   1. Exposed Conduit: RMC, IMC
   2. Underground Conduit: RNMC SCH 40 or 80
   3. Connection to vibrating equipment; including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment, chillers: LMFC
   4. Boxes and enclosures, aboveground: NEMA 4X
   5. Concealed inside exterior masonry wall: RMC, IMC.

C. Under interior slabs-on-grade:
   1. RMC, RNMC SCH 40, IMC

D. Interior (non-corrosive):
   1. Connection to vibrating equipment; including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment, chillers: LFMC
   2. Damp or wet Locations: RMC, IMC
   3. Boxes and enclosures: NEMA 250, Type 1
      a. NEMA 250, Type 4X, stainless steel in damp or wet locations.
   4. Exposed: RMC, IMC.

E. Building interior hazardous, corrosive:
   1. RMC
   2. Connection to vibrating equipment: PVC coated hazardous location rated flexible conduit, length shall be no longer than 28".

F. Exposed in tanks and wetwells:
   1. RNMC SCH 80.

G. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

END OF SECTION

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SECTION 26 22 13 - TRANSFORMERS

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. General Duty Energy Efficient Transformers.

B. Installation.

1.2 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

B. Include outline and support point dimensions of enclosures, unit weight, voltage, kVA, impedance, loss data, efficiency (at 25, 50, 75 and 100 percent of rated load), tap configurations, insulation system type and rated temperature rise.

C. Submit certified audible sound level test reports for each size and type of transformer.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store and protect equipment in a warm, dry location with uniform temperature. Cover ventilation openings to protect from dust and water.

B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, and snow if handled in inclement weather.

PART 2 -- EQUIPMENT

2.1 GENERAL PURPOSE ENERGY EFFICIENT DRY TYPE TRANSFORMERS

A. Provide ventilated, indoor, dry-type distribution transformer with the capacity and voltage characteristics indicated on the Drawings. Provide transformers 15 kVA and above designed to operate with a maximum 115 °C rise Temperature rise above 40°C ambient under full load. Provide all insulating materials for a 220 degrees C. insulation system.

B. Provide transformers meeting or exceeding NEMA Premium efficiency requirements.

C. Energy Star Labeled.

D. Provide continuous copper coil conductors with brazed or welded terminations.

E. Isolate transformer core and coil from the enclosure using vibration - absorbing mounts.

F. Provide transformers 75 kVA or less with enclosures suitable for wall, floor or trapeze mounting. Provide transformer larger than 75 kVA with enclosures suitable for floor or trapeze mounting.

G. Acceptable manufacturers:
1. Cutler Hammer
2. General Electric
3. Sola Hevi-Duty
4. Siemens
5. Square D
6. Power Smiths
7. Pre-approved equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Provide all brackets, hangers, and trapezes required to mount the unit. Support all suspended and all bracket mounted units from the building structure. Coordinate strength of wall for all wall mounted units. Refer to Section 26 05 29: “Supporting Devices” for additional requirements.

B. Place all transformers on elastomer isolator pads.

C. Make all connections to transformer using flexible conduit and maintain grounding continuity.

D. Provide terminal lugs listed for use with conductors rated 75° or higher.

E. Do not obstruct transformer ventilation openings nor mount within 12" of a roof deck. Maintain at least 12” space around transformer, or more if recommended in the manufacturer’s installation instructions.

F. Provide grounding of the transformer per Section 26 05 26: “Grounding and Bonding for Electrical Systems”.

G. Provide concrete pad for all floor-mounted transformers.

H. Line side disconnect/overcurrent protection device shall be lockable in closed position.

3.2 IDENTIFICATION

A. Provide permanently-installed nameplates on each transformer which identifies the transformer per the Contract Documents.

B. Were the line side disconnect is not located whithin sight and within 50’, contractor shall provide a self adhesive label on the transformer identifying the location of the disconnect.

3.3 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 26 24 11 - ELECTRICAL SERVICE

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. Metering Equipment.

B. Installation.

C. Utility Coordination.

1.2 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

B. Drawings submitted for approval of the service connection and metering cabinet shall include the following information as applicable to each piece of equipment:
   1. Detailed top, front, and end views.
   2. Outline dimensions, including weights.
   3. Isometric or equivalent single line bussing diagram showing sizes, material, plating, and rating of phase, neutral, and ground buses.
   4. Electrical line diagrams and schematics.
   5. Metering and other wiring diagrams.
   6. Component device and material lists.
   7. Nameplate entries and schedules.
   8. Features and accessories furnished to meet Specification requirements.
   9. Cable access and exit areas, termination spaces, pull boxes.

C. Operation and Maintenance Manuals shall be provided for each component. These manuals shall include but shall not be limited to the following:
   1. All shop drawing submittal information updated to show as-built conditions.
   2. Outline dimension prints, including weights.
   3. List of spares recommended for stock.
   4. Description of the operation, proper maintenance, and repair of all components.
   5. Local sources of service and supply.

PART 2 -- EQUIPMENT

2.1 METER SOCKET

A. Power Company approved meter socket.

2.2 CURRENT TRANSFORMER ENCLOSURE

A. NEMA 3R enclosure constructed of 14-gauge steel.

B. Hinged door with hasp and meter seal provisions.

C. Dimensions which comply with NFPA 70 and Power Company requirements.

D. ANSI 61 gray polyester powder coating finishes inside and outside over phosphatized surfaces.

E. Copper landing pads as required to mount Power Company's current transformers to terminate a single service entrance cable per phase and to terminate 3 cables per phase on the load side sized as shown on the Drawings.

F. Neutral bar for service entrance cables, grounding electrode conductor, and load cables.

G. Approved Manufacturers:
   1. American Midwest Power, Inc.
   2. Electro-Mechanical Industries (EMI), Inc.
   3. States Electric Mfg. Co.

4. Or equal.

2.3 VOLTAGE TRANSFORMER ENCLOSURE

A. NEMA 3R enclosure constructed of 14-gauge steel.

B. Hinged door with hasp and meter seal provisions.

C. Dimensions which comply with NFPA 70 and Power Company requirements.

D. ANSI 61 gray polyester powder coating finishes inside and outside over phosphatized surfaces.

E. Approved Manufacturers:
1. American Midwest Power, Inc.
2. Electro-Mechanical Industries (EMI), Inc.
3. States Electric Mfg. Co.
4. Or equal.

2.4 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Engraved phenolic, black face with white lettering.

B. Provide plate size as necessary to fit all lettering on it. Equipment of common type or function shall have nameplates of the same size.

PART 3 -- EXECUTION

3.1 SERVICE

A. Verify that the neutral to ground bond is in place at the service entrance equipment prior to energizing.

B. Enclosures shall be secured to floor/equipment pad with stainless steel hardware.

C. Provide the service feeder, wire in conduit, from the transformer or cable termination cabinet to the main distribution switchboard.

3.2 GROUNDING

A. Provide grounding per Section 26 05 26: Grounding and Bonding for Electrical Systems.

3.3 IDENTIFICATION

A. Provide signage as required by the NEC in addition to the requirements of the Contract Documents.

B. Provide identification nameplates as identified in the Contract Documents.
1. Install nameplate parallel to equipment lines.
2. Install nameplates outside covers using mechanical rivets or screws.
3. Nameplates shall be attached in such a manner not to void the equipment's 3rd party testing agency approvals.

3.4 COORDINATION OF WORK WITH THE UTILITY

A. Power company will be responsible for the following:
1. Furnishing and installing the primary overhead conductors and pole line.
2. Furnishing and installing the riser pole, primary cutouts, lightning arresters, and grounding.
3. Furnishing and installing underground primary conduits and cables.
4. Furnishing and installing transformer.
5. Termination of underground primary cables at riser pole.
6. Termination of underground primary cables at the transformer.
7. Termination of secondary conductors at the transformer.

B. Contractor will be responsible for the following:
1. Make all arrangements with the power company for obtaining electrical service, obtaining, and completing all forms required by the utility, and furnish all labor and material required for the electrical service which the utility does not provide.

2. Completing power company load forms, if required by the Utility.
3. Verifying locations of power company equipment with the power company.
4. Furnish secondary conduits and cables.
5. CT and VT connection cabinet.
6. Furnish and install power company approved metering enclosures.
7. Terminating all secondary conductors at the service entrance equipment.
8. Terminating and providing conductors required for the metering cabinet.

C. The contractor shall coordinate utility requirements with the utility prior to bidding. The contractor shall provide and install equipment which is supplied but not installed by the power company as part of the Contract Document base bid.

D. The cost of the work which the power company provides shall not be included in the Bid Price, unless noted or requested otherwise.

3.5 UTILITY FORMS AND DOCUMENTATION

A. The contractor is responsible for completing and submitting utility load forms.

B. The contractor shall obtain and complete all forms to apply for all applicable equipment rebates available from the power company serving the project.

C. The contractor is responsible for all scheduling and coordination with the Electric Utility. Engineers cannot be held responsible for delays in schedules, providing information, or completing power company forms.

3.6 TESTING AND COMMISSIONING

A. The contractor shall provide trained personnel to inspect all components after installation and shall make all necessary corrections and parameter programming before the equipment is tested.

B. Contractor shall gain approval from the electric utility serving the project prior to energizing equipment.

END OF SECTION

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SECTION 26 24 15 - TRANSFER SWITCHES

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switches.

1.2 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 05 00, in addition to the below requirements.

B. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

C. Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

D. Single-Line Diagram: Show connections between transfer switch, power sources, and load;

E. Field quality-control test reports.

F. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Features and operating sequences, both automatic and manual.
   2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA ICS 1.

D. Comply with NFPA 70.

E. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 -- PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH

A. Automatic transfer switches shall comply with UL, NEMA, NEC, ANSI, IEEE, and NFPA, and have the following features:

B. Open transition switches, 3 pole, electrically operated, mechanically held open contact type, without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.

C. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.

D. Ratings:
   1. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as indicated in the Contract Documents.

2. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
3. For automatic transfer switch without integral overcurrent protection, contractor shall coordinate appropriate upstream protection device to provide adequate ampere interrupting capacity (AIC) rating of the transfer switch.

E. Markings:
1. Markings shall be in accordance with UL 1008.

F. Tests:
1. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.

G. Surge Withstand Test:
1. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.

H. Housing:
1. Enclose automatic transfer switches in wall mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings.
2. Enclosure shall be constructed so that personnel are protected from energized components during automatic transfer switch maintenance.
3. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.

I. Operating Mechanism:
1. Actuated by an electrical operator.
2. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal and emergency position.
3. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
4. Contact transfer time shall not exceed six cycles.
5. Operating mechanism components and mechanical interlocks shall be insulated or grounded.

J. Contacts:
1. Main contacts: Silver alloy.
2. Neutral contacts: Silver alloy, with same current rating as phase contacts.
3. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.
4. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
5. Isolated form 'C' contacts shall be provided for remote indication of
    a. Normal power available.
    b. Generator power available.
    c. Switch in normal position.
    d. Switch in generator position.

K. Manual Operator:
1. Capable of operation by one person in either direction under no load.

L. Replaceable Parts:
1. Include the main and arcing contacts individually or as units, as well as relays, and control devices.
2. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.

M. Sensing Features:
   1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.
   2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   3. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
   4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   5. Test Switch: Simulate normal-source failure.
   6. Switch-Position Indication: Indicate source to which load is connected.
   7. Source-Available Indication: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
   8. Normal Power Indication: Indicate "Normal Source Available."
   9. Emergency Power Indication: Indicate "Emergency Source Available."
   10. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Control panel shall indicate override status.
   11. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.
   12. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

N. Controls:
   1. Controls shall provide indication of switch status and be equipped with alarm diagnostics.
   2. Controls shall control operation of the automatic transfer switches.
   3. The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability. The digital display shall be accessible without opening the enclosure door and shall be provided with a 4 line by 20 character LCD display screen with touch pad function and display menus. The programming functions shall be pass code protected. The control panel shall be optoisolated from electrical noise and provided with the following inherent control functions and capabilities:
      a. Multipurpose display for continuous monitoring and control of the ATS functions and settings. All field changeable functions shall be pass code protected and accessible through the keypad.
      b. Built-in diagnostic display that includes the capturing of historical data, such as number of transfers and time on emergency power source for ease of troubleshooting.
      c. Touch pad test switch with Fast Test/Load/No Load positions to simulate a normal source failure.

O. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.

P. Provide input and control logic to allow operator to operate the facility on generator power via the SCADA system for extended periods of time while still maintaining the logic to automatically switch back to normal power should the generator fail.

Q. A load/no load clock exerciser shall be incorporated within the microprocessor and shall be programmable to start the engine generator set and transfer the load (when selected) for exercise purposes on a weekly basis. The exerciser shall contain a lithium battery for memory retention during an outage.

R. Approved Manufacturers:
   1. ABB

2. ASCO
3. Pre-approved equal.

2.2 SEQUENCE OF OPERATION

A. Manual Operation:
1. Operator shall use the control panel on the face of the enclosure to activate the switch to change positions.
2. When a Manual transfer is initiated, the system shall transfer from normal power to generator and vice versa pending the switch present position.
3. Automatic transfer operation shall be disabled.

B. Automatic Operation:
1. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified time delay to permit override of momentary dips in the normal power source.
2. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator(s) have attained the specified percent of rated value.
3. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.
4. Retransfer to Normal Source: Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Should the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s) shall continue to run unloaded for a specified interval (initially set to 5 minutes) before shut-down.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Secure free-standing equipment to a concrete housekeeping pad with the use of stainless-steel hardware.

B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
1. Review wiring and connection to ensure all conductors and terminals have been properly installed.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Perform contact-resistance test across main contacts and correct values exceeding 500 microohms and values for 1 pole deviating by more than 50 percent from other poles.
   f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measure insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Coordinate this training with that for generator equipment.

END OF SECTION

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SECTION 26 24 16 - PANELBOARDS

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. Distribution panelboards

B. Lighting and appliance panelboards.

C. Installation.

D. Identification.

1.2 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

B. Drawings submitted for approval of panelboards shall include the following information as applicable to each piece of equipment:
   1. Detailed top, front, and end views.
   2. Outline dimensions, including weights.
   3. Isometric or equivalent single line bussing diagram showing sizes, material, plating, and rating of phase, neutral, and ground buses.
   4. Electrical line diagrams and schematics.
   5. Metering and other wiring diagrams.
   6. Component device and material lists.
   7. Cutsheets for each individual breaker, fuse, compartment, and accessory.
   8. Nameplate entries and schedules.
   9. Features and accessories furnished to meet Specification requirements.
   10. Cable access and exit areas, termination spaces, pull boxes.

C. Operation and Maintenance Manuals shall be provided for each component. These manuals shall include but shall not be limited to the following:
   1. All shop drawing submittal information updated to show as-built conditions.
   2. Outline dimension prints, including weights.
   3. List of spares recommended for stock.
   4. Description of the operation, proper maintenance, and repair of all components.
   5. Local sources of service and supply.

1.3 QUALITY ASSURANCE

A. All panelboards provided shall be of the same manufacturer.

PART 2 -- EQUIPMENT

2.1 DISTRIBUTION PANELBOARDS

A. Provide distribution panelboard assemblies adhering to the following specifications:
   1. Enclosures constructed of galvanized sheet steel of thickness as required by Code, with enameled steel trim, distributed busing, hinged steel doors latches, locks, and adjustable trim clamps.
      a. Provide 2 keys for each panelboard.
      b. All panelboards shall be keyed alike.
   2. Provide NEMA 3R enclosures for exterior locations.
   3. Provide 90” high enclosure with full busing where “full height” panels are indicated on the plans.
   4. Provide welded metal frame with typed circuit directory for each panel.
   5. Compliant to the following standards: UL 50, UL 67, NEMA PB-1, NFPA 70 and Fed. Spec W-P-115C
   6. Provide panelboards with interrupting ratings as shown on the plans. Provide switchboards, panelboards, and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings using series-rated equipment is not permitted.

7. Provide 600 volt rated panelboards.
8. Provide sub feed or feed through lugs as indicated on the plans.
9. Provide tin-plated copper bus bars.
10. Provide proper lugs (75° C. minimum temperature rating) and gutter space for cable size indicated on the plans.
11. Provide service entrance ratings where required.
12. Trim shall be attached directly to the box with screws; trim clamps shall not be used.
13. Ampere Interrupting Ratings: As indicated on the drawings.

B. Circuit Breakers:
1. Thermal magnetic, molded case circuit breakers. Refer to the Contract Document schedules for sizes and quantities.
2. Operating mechanisms shall be with provisions for padlocking in the open position.
3. Multi-pole breakers with a common trip.
4. Circuit breakers with an ampere rating of 100A or greater shall be provided with solid state trip with adjustable LSI trip settings to provide a coordinated system.
5. Series rating of circuit breakers is not allowed.
6. Branch mounted main breakers are not allowed.
7. GFCI rated breakers:
   a. Class A GFCI protection, HACR rated.
   b. Sense current imbalance of 4 milliamps or greater.
   c. Ground fault sensor to trip the circuit upon current imbalance.
   d. Test pushbutton on breaker.
   e. Trip indicator.
   f. 1-pole breakers rated 15-30 amperes.
   g. 2-pole breakers rated 15-60 amperes.
8. AFCI rated breakers:
   a. Trip indicator.
   b. HACR, SWD rated.
   c. Test pushbutton on breaker.
   d. Selective arc trip sensing.

C. Acceptable Manufacturers:
1. Square D type I-Line series
2. Siemens type P4 and P5 series
3. Cutler Hammer Pow-R-Line 4B series
4. ABB ReliaGear
5. Pre-approved equal

2.2 LIGHTING AND APPLIANCE PANELBOARDS

A. Provide lighting and appliance panelboard assemblies adhering to the following specifications:
1. Enclosures constructed of galvanized sheet steel of thickness as required by Code, with Door in door front, complete with trim, doors, flush chrome plated cylinder lock, catch, and directory with clear plastic cover.
   a. Provide 2 keys for each panelboard.
   b. All panelboards shall be keyed alike.
2. Provide NEMA 3R enclosures for exterior locations.
3. Provide welded metal frame with plastic-covered machine typed circuit directory for each panel. Directory cards must be removeable to allow updating off-site if necessary. Permanently adhered panel directories are not allowed.
4. Compliant to the following standards: UL 50, UL 67, NEMA PB-1, NFPA 70 and Fed. Spec W-P-115C, UL 489, NEMA AB-1, Fed. Spec. W-C-375B/GEN, IEC 157-1, and BS 4752.
5. Provide 240-volt AC rated panelboards.
6. Provide sub feed or feed through lugs as indicated on the plans.
7. Provide tin-plated copper bus bars.

8. Provide proper lugs (75° C. minimum temperature rating) and gutter space for cable size indicated on the plans.
9. Provide service entrance ratings where required.
10. Trim shall be attached directly to the box with screws; trim clamps shall not be used.
11. Ampere Interrupting Ratings: As indicated on the drawings.

B. Circuit Breakers:
1. No breaker shall be larger than 100A, except for the main breaker.
2. Provide molded case, non-adjustable, thermal-magnetic, quick-make, quick-break, type circuit breakers. Refer to the Contract Document schedules for sizes and quantities.
3. Provide multi-pole breakers when indicated on the schedules.
4. Breaker handle ties on single pole breakers are not acceptable.
5. Tandem breakers are not allowed.
6. Provide circuit breakers with engraved ratings on the handle that are visible without removing the panel cover.
7. Series rating of circuit breakers is not allowed.
8. Branch mounted main breakers are not allowed.
9. GFCI rated breakers:
   a. Class A GFCI protection, HACR rated.
   b. Sense current imbalance of 4 milliamps or greater.
   c. Ground fault sensor to trip the circuit upon current imbalance.
   d. Test pushbutton on breaker.
   e. Trip indicator.
   f. 1-pole breakers rated 15-30 amperes.
   g. 2-pole breakers rated 15-60 amperes.
10. AFCI rated breakers:
   a. Trip indicator.
   b. HACR, SWD rated.
   c. Test pushbutton on breaker.
   d. Selective arc trip sensing.

C. Acceptable Manufacturers:
1. 240 volts
   a. Square D type NQOD or NF
   b. Siemens type P1 series
   c. Cutler Hammer Pow-R-line 1a series
   d. ABB ReliaGear
   e. Pre-approved equal
2. 480 volts
   a. Square D type NF
   b. Siemens type P1 series
   c. Cutler Hammer Pow-R-line 2a series
   d. ABB ReliaGear
   e. Pre-approved equal

2.3 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Minimum 1/8” thick laminated bakelite: White face with black lettering.

B. Engrave characters with a minimum height of 1/4".

C. Minimum plate size: 1” x 3.5”. Provide larger plate if necessary to fit all lettering on it.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Distribution Panelboards:
   1. Mount panels and cabinets to the building structure or interior wall construction. Mount independent of conduit and raceways entering boxes.
   2. Provide 1" empty conduits from each flush mounted panel. When the floor is on grade, provide three (3) conduits into the ceiling cavity above. When the floor has accessible space below, provide three (3) conduits into the ceiling space above and two (2) conduits into the accessible space below the floor. Ends shall be capped and shall be tagged at both ends with permanent tags.
   3. Provide concrete housekeeping pads under all floor-mounted or free-standing distribution panelboard.
   4. Provide a circuit directory completely machine typed on the interior of each panel door.

B. Lighting and Appliance Panelboards:
   1. Mount panelboards and cabinets to the building structure or interior wall construction. Mount independent of conduit and raceways entering boxes.
   2. Mount panelboards with topmost overcurrent device no higher than allowed by the NEC (6’-7”) above finished floor.
   3. Provide 1" empty conduits from each flush mounted panelboard. When the floor is on grade, provide three (3) conduits into the ceiling cavity above. When the floor has accessible space below, provide three (3) conduits into the ceiling space above and two (2) conduits into the accessible space below the floor. Ends shall be capped and shall be tagged at both ends with permanent tags.
   4. Provide each circuit in the panel(s) with a circuit number securely fastened to the breaker for identification purposes.
   5. Provide a circuit directory completely machine typed on the interior of each panel door.

C. Provide HACR, GFCI and AFCI rated breakers which meet the requirements of NFPA 70 in addition to when noted on the panelboard schedules.

D. Panelboard schedule designations are as follows:
   1. Blank: Not intended for use.
   2. Space: Contains necessary bus and hardware for future addition of breakers.
   3. Spare: Contains a complete breaker installed, size as shown on schedule.

E. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to/from other enclosures or devices.

3.2 GROUNDING

A. Provide grounding per Section 26 05 26: Grounding and Bonding for Electrical Systems.

3.3 IDENTIFICATION

A. Provide signage as required by the NEC in addition to the requirements of the Contract Documents.

B. Provide identification nameplates as identified in the Contract Documents.
   1. Install nameplate parallel to equipment lines.
   2. Install nameplates outside covers using mechanical rivets or screws.
   3. Nameplates shall be attached in such a manner not to void the equipment’s 3rd party testing agency approvals.

END OF SECTION

SECTION 26 24 18 - SURGE PROTECTION DEVICES

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. Surge protection devices

B. Installation

1.2 DEFINITIONS

A. $I_{nominal}$: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.3 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

B. Drawings submitted for approval of the main switchboard and the service connection and metering cabinet shall include the following information as applicable to each piece of equipment:
   1. Detailed top, front, and end views.
   2. Outline dimensions, including weights.
   3. Component device and material lists.
   4. Nameplate entries and schedules.
   5. Features and accessories furnished to meet Specification requirements.
   6. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Operation and Maintenance Manuals shall be provided for each component. These manuals shall include but shall not be limited to the following:
   1. All shop drawing submittal information updated to show as-built conditions.
   2. Outline dimension prints, including weights.
   3. List of spares recommended for stock.
   4. Description of the operation, proper maintenance, and repair of all components.
   5. Local sources of service and supply.
   6. Warranty documents and point of contact for warranty claims.

PART 2 -- EQUIPMENT

2.1 GENERAL REQUIRMENTS FOR ALL SURGE PROTECTION DEVICES

A. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 latest edition, section 37. MCOV values claimed based on the component's value or on the 30-minute 115% operational voltage test, section 38 in UL1449 will not be accepted.

B. Unit shall have no more than 10% deterioration or degradation of the UL1449 latest edition Voltage Protection Rating (VPR) when exposed to a minimum of 5,000 repeated category C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.

C. Protection Modes UL1449 4th Edition VPR for grounded WYE/delta and High Leg Delta circuits. 3-Phase, 4 wire circuits, split phase shall be as follows and comply with test procedures outlined in UL1449 section 37.6:

SYSTEM VOLTAGE	MODE	MCOV	B3 RINGWAVE 6KV, 500A	C3 COMB. WAVE 20KV, 10KA	UL1449 VPR RATING
120/240 120/208	L-N	150	490	980	700
	L-G	150	570	980	700
	N-G	150	640	1170	700
	L-L	300	500	1600	1200
277/480	L-N	320	450	1420	1200
	L-G	320	540	1540	1200
	N-G	320	570	1600	1000
	L-L	552	530	2600	2000

D. Electrical Noise Filter: each unit shall include a high performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B.
   1. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.

E. The UL1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.

F. The UL1449 Nominal Discharge Surge Current Rating shall be 20kA

G. The SCCR rating of the SPD shall be 200kAIC without the need for upstream over current protection.

H. SPD shall be provided in a NEMA rated enclosure suitable for the environment of which it is to be installed.

I. Manufacturer: All devices shall be provided from one manufacturer and be subject to compliance with requirements. The listing of a manufacturer as acceptable does not imply automatic approval. Submitted products must meet all performance parameters outlined in the specification. Provide products by one of the following:
   1. ABB
   2. ASCO
   3. Liebert
   4. APT
   5. Or approved equal.

2.2 SERVICE SURGE PROTECTION DEVICE (SPD)

A. To be used at the electrical service entrance where required per the Contract Documents.

B. The system shall be constructed of a single replaceable surge module, utilizing thermally fused and protected metal oxide varistors (MOVs), surge-rated copper bussing, and capacitive filtering. The system shall be a Type 1 SPD, rated for use on service entrance without the use of a separate overcurrent protection device. SPD devices that contain multiple replaceable surge modules may be acceptable but are required to replace all surge modules should any one of them fail.

C. Minimum Single Pulse Surge Current Capacity based on ANSI/IEEE 8x20 microsecond wave shape. Surge currents shall be verified by an independent 3rd party test lab. Calculated surge ratings based on the arithmetic sum of the surge components used in the construction of the product will not be accepted.
   1. 100,000 amps, L-N
   2. 100,000 amps, L-G
   3. 100,000 amps, N-G
   4. 200,000 amps, L-L (L-N + L-G modes)

D. The unit shall be able to prevent common temporary overvoltages and high impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and intermediate current TOV's, as specified in UL 1449 article 39, can be caused by a loss of the neutral conductor in a split phase or three phase power system. The available fault current will be determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

Overvoltage seen by MOV's as % of Nominal Voltage				
	Available current			
Time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

E. Integral Disconnect Switch:
   1. The device shall have an NEMA compliant safety interlocked integral disconnect switch with an externally mounted manual operator.
   2. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
   3. The switch shall be rated for 600Vac.
   4. The SPD device shall be tested to UL1449 latest edition listed with the integral disconnect switch and the UL1449 VPR ratings shall be provided.
   5. The integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.
   6. The line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.

F. The SPD shall be listed as Type1 SPD, suitable for use in Type1 or Type2 applications.

G. The SPD shall have the following monitoring options.
   1. Time Date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase)
   2. SPD monitoring shall track surge protection and display it as a percentage
   3. SPD shall provide a surge counter with three categories to be defined as Low Level surge (100A-500A), Medium Level surge (500A-3,000A), High Level surge (>3,000A)
   4. Remote communications via ModBus or Ethernet

H. 20-year full replacement warranty.

PART 3 -- EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Use crimped connectors and splices only. Wire nuts are unacceptable.

B. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not exceed manufacturer's recommended lead length.

C. Do not splice and extend SPD leads unless specifically permitted by manufacturer.

D. Do not bond neutral and ground.

E. SPD shall be installed in location to minimize cable lengths. If installed lead length exceeds 5' installer shall use a low impedance (HPI) cable to reduce the lead length effect on the installed performance of the SPD per manufacturer recommendations.

3.2 GROUNDING

A. Provide grounding per Section 26 05 26: Grounding and Bonding for Electrical Systems.

3.3 STARTUP AND TESTING

A. The SPD manufacturer's technician shall perform a system checkout and start-up in the field to assure proper installation, operation and to initiate the warranty of the system. The technician will be required to do the following:
   1. Verify voltage clamping levels utilizing a diagnostic test kit, comparing factory readings to installed readings.
   2. Verify N-G connection.
   3. Record information to a product signature card for each product installed.

B. Complete startup checks with the assistance of a factory-authorized service representative.

C. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests and reconnect them immediately after the testing is over.

D. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 IDENTIFICATION

A. Provide signage as required by the NEC in addition to the requirements of the Contract Documents.

B. Provide identification nameplates as identified in the Contract Documents.
   1. Install nameplate parallel to equipment lines.
   2. Install nameplates outside covers using mechanical rivets or screws.
   3. Nampelate shall be attached in such a manner not to void the equipment's 3rd party testing agency approvals.

END OF SECTION

SECTION 26 24 19 - MOTOR CONTROL

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. Section includes:
   1. Motor Control Centers
   2. Variable frequency drivers.
   3. Full-voltage magnetic controllers.
   4. Solid state reduced voltage starters.
   5. Wall mounted starters.
   6. Manual motor starters.
   7. Installation.

1.2 DEFINITIONS

A. CPT: Control power transformer.

B. EMI: Electromagnetic interference.

C. GFCI: Ground fault circuit interrupting.

D. IGBT: Insulated-gate bipolar transistor.

E. LAN: Local area network.

F. LED: Light-emitting diode.

G. MCC: Motor-control center.

H. MCCB: Molded-case circuit breaker.

I. MCP: Motor-circuit protector.

J. NC: Normally closed.

K. NO: Normally open.

L. OCPD: Overcurrent protective device.

M. PCC: Point of common coupling.

N. PID: Control action, proportional plus integral plus derivative.

O. PT: Potential transformer.

P. PWM: Pulse-width modulated.

Q. RFI: Radio-frequency interference.

R. SCR: Silicon-controlled rectifier.

S. TDD: Total demand (harmonic current) distortion.

T. THD(V): Total harmonic voltage demand.

U. SPD: Surge Protection Device

V. VFC: Variable-frequency motor Controller.

W. VFD: Variable-Frequency Drive

1.3 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

B. Product Data: For each type of motor controller, include the following:
   1. Shipping and operating weights.

2. Shipping splits.
3. Dimensioned plans and elevation diagrams.
4. Enclosure type and construction material.
5. Electrical ratings; Voltage, Current, and KAIC rating.
6. Conductor lug size ratings.
7. Conduit entry locations.
8. Schematic wiring diagrams that show power, signal, and control wiring for each installed controller.
9. Factory installed devices.
10. Nameplate legends.
11. Furnished specialties and accessories.
12. System and operating description.
13. Parts list.
14. Local sources of supply and service.

C. Manufacturers Installation Instructions:
1. Submit with shop drawings.
2. Include documents with shipment.

D. Spare Parts:
1. Provide a list of recommended spare parts with unit prices.
2. Provide with the Operation and Maintenance Manual.

E. Operation and Maintenance Manual:
1. Shall meet the requirements of Division 1 and Section 26 05 00.
2. Operating instructions for equipment.
3. Wiring and installation instructions for equipment.
4. Settings, adjustments, and calibrations for equipment as required.
5. Recommended maintenance schedules and procedures for equipment.
6. Equipment manufacturer's name, address, and telephone number.
7. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
8. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.
9. Sample of special warranty offered by Manufacturer, Supplier or Contractor, if any.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain motor controllers of a single type from single source from single manufacturer.

B. 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.

C. Comply with NFPA 70.

D. The manufacturer of the equipment shall have 2 stocking distributors of spare parts located within the 150 miles of the project site.

E. Manufacturers of the variable frequency drives and reduced voltage starters shall have factory-trained service personnel, test equipment, and a distributor which stocks replacement parts all located within 150 miles of the project site.

1.5 COORDINATION

A. Coordinate features of equipment, and accessory devices with remote pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each controller and each installed unit with ratings and characteristics of supply circuits, motors, required control sequences, and duty cycle of motors and loads.

C. The contractor shall verify that the equipment being furnished can be installed in the available space. If available space is not adequate for the proposed equipment, Contractor shall notify the Engineer before releasing the equipment for manufacturing. The contractor shall be responsible for correcting equipment spacing conflicts which were not identified and coordinated with the Engineer prior to releasing the equipment for manufacturing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in shipping splits of lengths that can be moved past obstructions in delivery paths.

B. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside enclosures, and install temporary electric heating, with at least 250W per vertical section or connect factory-installed space heaters to a temporary electrical service as required to protect equipment from freezing and/or condensation.

PART 2 -- PRODUCTS

2.1 MOTOR CONTROL CENTER

A. Approved Manufacturers:
1. Eaton
2. Allen-Bradley Brand
3. Square D
4. ABB

B. Functional Features:
1. Description: Modular arrangement of main units, controller units, control devices, feeder-tap units, instruments, metering, auxiliary devices, and other items mounted in vertical sections of MCC.
2. NEMA ICS2 construction.
3. NEMA Class I, Type B, dead-front, free standing, factory assembled.

C. Indoor Enclosures:
1. Freestanding steel cabinets unless otherwise indicated.
2. NEMA 250, Type 1 with gasketed doors, unless otherwise indicated to comply with environmental conditions at installed location.
3. Factory-applied finish in manufacturer's standard color finish over a rust-inhibiting primer on treated metal surface.

D. Compartments:
1. Modular, individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on units to require disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
2. Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
3. Install modular units up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being installed into their normal, energized positions.
4. Feeder-Tap Units: Through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being installed into their normal, energized positions.
5. Equip units in Type B modular units with pull-apart terminal strips for external control connections.
6. Front-mounted unit, except where back-to-back units are designated in the Contract Documents.
7. Future Units: Compartments fully bused and ready for insertion of drawout units.
8. Spare Units: Installed in compartments indicated "spare."
    a. Unused space shall be complete with doors and other accessories required for the insertion of future Size 1 or Size 2 FVNR starter units, unless noted otherwise.

E. Cubicles

1. Totally enclosed.
2. Effectively baffled to isolate any ionized gases which may occur within starter unit.
3. Modular design to allow unit layout or re-configuration in any combination without structural interference.
4. Disconnecting (pull-apart) type terminal strips. Terminals permanently marked with the number which appears on the schematic and wiring diagrams.
5. Provide surge suppressors on control relays as recommended by the manufacturer in addition to surge protection devices specified in the Contract Documents.

F. Sections:
1. Vertical sections nominally 20-inches wide, 20-inches deep, and 90-inches high unless noted otherwise on Drawings.
2. Each section is capable of top or bottom conduit entry.
3. Corner sections with bus where MCC's turn corners.

G. Wiring Spaces:
1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports hold wiring in place.
2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

H. Incoming Mains:
1. Provide incoming mains as shown on the Contract Documents.
2. Main Lugs Only: Conductor connectors suitable for use with conductor material and sizes.
   a. Material: Hard-drawn copper, 98 percent conductivity.
   b. Provide quantity, size, and ratings suitable for conductor size and material.

I. Electrical:
1. Voltage, phase, and current ratings as specified in the Contract Documents.
2. Main horizontal bus:
   a. Copper bus with continuous current rating as specified in the Contract Documents.
   b. Uniform capacity for the entire length of the MCC.
   c. Provide provisions for future extensions at ends of MCC not abutted to a wall or other equipment.
3. Vertical buses:
   a. Rated for 300 amp minimum.
   b. Tin plated copper with insulating barriers.
   c. Uniform capacity for the entire usable height, except for sections incorporating single units.
4. Neutral Bus:
   a. Tin-plated copper, isolated bus.
   b. 100% of the phase buses' ampacity.
   c. Provide where required to feed wall mounted panelboards or equipment where a neutral is required.
   d. The neutral bus does not need to extend the entire length of the MCC.
5. Ground Bus:
   a. Copper ground bus.
   b. Extends the full length of the control center with lugs for terminating conductors.
   c. Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.
6. The entire motor control center, including bussing, disconnects, circuit breakers, and combination motor starter units shall have bracing and adequate interrupting capacity for connecting to a system.
7. Disconnects, circuit breakers, and motor circuit protectors shall have means for padlocking in the open position.

J. Pilot Devices:
1. Devices shall be 30mm.
2. The lights shall be LED push-to-test transformer type.

K. Identification:
   1. Each unit identified with an engraved phenolic nameplate attached with stainless steel screws.
   2. Lettering shall be 1/4 inch high, white on a black background.

2.2 VARIABLE FREQUENCY DRIVES (VFD'S)

A. Shall be electronic, with adjustable frequency and voltage, three phase output, capable of driving three-phase induction motors at full rated speed. The control technique shall be pulse width modulation (PWM) waveform, utilizing a full wave bridge design incorporating diode rectifier circuitry (third generation IGBT power electronics). Silicon controlled rectifiers or other control techniques are not acceptable.
   1. Standard Drives (100 HP and below): Front end shall be a full wave diode bridge rectifier (6-pulse). VFD shall include a DC link-choke equivalent of a 3%-line reactor on the line side, located within the VFD enclosure.

B. Suitable for variable or constant torque loads, as required per the application.

C. Shall be capable of providing sufficient torque to allow the motor to break away from rest upon first application of power.

D. Shall operate within voltage parameters of plus 10 to minus 15 percent of line voltage and be suitably rated for the full load amps of the maximum watts (HP) within its class.

E. Minimum efficiency:
   1. 95 percent at full rated speed.
   2. 85 percent at half of the rated motor speed.

F. Displacement power factor shall not be less than 95 percent under any speed or load condition.

G. Surge Suppression:
   1. Provide three-phase protection against damage from supply voltage surges in accordance with UL 1449.

H. VFD shall have the additional following features:
   1. Isolated power for control circuits.
   2. Manually resettable overload protection for each phase.
   3. Adjustable current limiting circuitry to provide soft motor starting. Maximum starting current shall not exceed 200 percent of motor full load current.
   4. Independent acceleration and deceleration time adjustment, manually adjustable from 2 to 2000 seconds. Set timers to the equipment manufacturer's recommended time in the above range.
   5. Speed Control input circuitry:
      a. 4 to 20 mA current or 0-10 VDC voltage control signals from an external source.
      b. Digital input from an external source.
      c. Manual via the local interface.
   6. Automatic frequency adjustment from 1 Hz to 300 Hz.
   7. Circuitry to initiate an orderly shutdown when any of the conditions listed below occur. The VFD shall not be damaged by any of these electrical disturbances and shall automatically restart when the conditions are corrected. The VFD shall be able to restart into a rotating motor operating in either the forward or reverse direction and matching that frequency.
      a. Incorrect phase sequence.
      b. Single phasing.
      c. Overvoltage more than 10 percent.
      d. Undervoltage more than 15 percent.
      e. Running overcurrent above 110 percent (VSMC shall not automatically reset for this condition.)
      f. Instantaneous overcurrent above 150 percent (VSMC shall not automatically reset for this condition).
      g. Short duration power outages of 12 cycles or less (i.e., distribution line switching, generator testing, and automatic transfer switch operations.)
      h. Automatic Power Transfer and Power Loss:
         1) VFD shall automatically repower and be ready to operate after power is restored.

2) Provide automatic shutdown upon receiving a power transfer warning signal from an automatic transfer switch. VSMC shall automatically restart motor after the power transfer.
3) Automatic Reset/Restart: Attempt three restarts after VFD fault or on return of power after an interruption and before shutting down for manual reset or fault correction, with adjustable delay time between restart attempts.
4) Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Auto Speed Search" feature is available and engaged.
5) Bidirectional Auto Speed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to VFD, motor, or load.

I. VFD shall include front-accessible operator station, with sealed keypad and digital display, which allows complete programming, operating, monitoring, and diagnostic capabilities.
1. Typical control functions shall include but not be limited to:
a. HAND-OFF-AUTOMATIC with manual speed control in HAND mode.
2. Typical monitoring functions shall include but not be limited to:
a. Output frequency (Hz).
b. Motor speed and status (run, stop, fault).
c. Output voltage and current.
3. Typical fault and alarm functions shall include but not be limited to:
a. Loss of input signal, under- and over-voltage, inverter overcurrent, motor overload, critical frequency rejection with selectable and adjustable dead bands, instantaneous line-to-line and line-to-ground overcurrent, loss-of-phase, reverse-phase, and short circuit.
b. System protection indicators to indicate that the system has shut down and will not automatically restart.
4. Interface shall allow the operator to adjust all application, protection, programming, and control parameters.
5. Operator station shall be mounted on the front exterior of the enclosure door.

J. Hardware, software, network interfaces, gateways, and programming to control and monitor the VFD by control systems specified in other specification sections.
1. VFD shall include two N.O. and two N.C. dry contacts rated 120 Volts, 10 amperes, 60 Hz, in addition to other contacts to provide the control features as specified in other sections.

K. Enclosure:
1. VFD and specified accessories, including but not limited to filter/reactors and bypass when to be provided per the Contract Documents, to be mounted inside a single enclosure.
2. UL listed.
3. Dimensions to be equal or less than that indicated in the Contract Documents.
a. Where a conflict may be present, Contractor shall notify Engineer no less than 4 business days before the bid opening. If Contractor fails to do so and a conflict is present, Contractor is responsible for all corrective measures and costs with no additional costs to Owner.
4. Circuit breaker which will disconnect all input power, interlocked with the door so that the door cannot be opened with the circuit breaker in the closed position. Circuit breaker operator handle mounted on the exterior of the enclosure outer door.
5. SCCR rating which exceeds the available short circuit current in the circuit at the point of the connection.
6. Continuous hinged front door.
7. An emergency stop push button as required by U.L. or other devices as specified in the Contract Documents mounted on exterior door.
8. Ventilation/Cooling: ventilation and/or cooling shall be per manufacturer to maintain proper operating temperature for the components in the enclosure. Cooling and/or ventilation shall be adequate for the environment where the enclosure is mounted per the Contract Documents.
a. Ventilation – As recommended by equipment manufacturer:
1) Thermostatically controlled vent fan and fixed intake/discharge louvers.

2) Air filters, filter retainer, filter sealing gasket and finger guard.
b. Air Conditioning – As recommended by equipment manufacturer:
1) Closed loop air conditioner with removable filter and integral thermostat.
2) UL Listed for application.
3) Powered by VFD power feeder circuit. A separate feeder circuit for the air conditioner will not be accepted.
9. Wall mounted or floor mounted, as indicated on the Contract Documents.
a. When floor mounted, provide a 2" housekeeping pad under the enclosure.
10. NEMA 1 or 12 when located indoors in a dry location.
11. Operator station shall be mounted on the front exterior of the enclosure door.

L. Harmonic Distortion
1. Current and voltage harmonic distortion shall not exceed the values allowed by IEEE 519.
2. Drives shall be designed to limit the harmonic currents which are generated on the AC service, and which would produce electromagnetic interference (EMI) or radio frequency interference (RFI). Individual current harmonic distortion and the total demand distortion expressed as percent of maximum demand load current shall not exceed the values specified in IEEE 519 – Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, Table 10.3.
3. Total Harmonic Distortion (THD) shall not exceed 5 percent, and individual voltage harmonic distortion shall not exceed 3 percent per IEEE 519.
4. If the drives generate objectionable interference, EMI or RFI drive manufacturer shall provide the specifications for the equipment required to reduce it to acceptable levels. The VFD supplier shall have in possession filters to alleviate interference if encountered.
5. The Owner will provide the equipment specified to correct the problem through a direct purchase or a Change Order to the Contract.

M. Manufacturers
1. Standard Drives:
a. Square D ATV660
b. Allen Bradley Power Flex 753
c. ABB ACQ580
d. Eaton Power XL DG1
e. Danfoss VLT AQUA

2.3 MOTOR STARTERS

A. General Characteristics:
1. The starter contactors are manufactured to NEMA standards.
a. NEMA-sized IEC devices not acceptable.
2. NEMA 1 minimum starter size for installation in MCC, otherwise as indicated on drawings.
3. Fault current withstand rating equivalent to rating of horizontal main bus.
4. Line plug-in, pull-out, lock-out type.
a. Provide guides in structure for supporting and aligning starter during removal or replacement.
b. Tin-plated, pressure-type high strength copper stab assembly for connection to vertical bus.
c. Lock-out latch to padlock unit in "pull-out" position and isolate entire unit from bus.
5. Coil:
a. 120 volts, 60 HZ.
b. Molded construction.
6. Control power transformer mounted in each starter operating at other than 120V single-phase.
a. Size transformer with an extra 50VA capacity.
b. Two primary fuses, and a single secondary fuse.
c. Where the control voltage is used for motor protection circuits, the control power circuit shall be run through an auxiliary contact on the motor's local disconnect device to discontinue control power when the disconnect switch is in the open position.
7. Auxiliary Contacts:
a. Minimum of 2 N.O. field convertible auxiliary contacts per starter.
b. Minimum of 1 N.O. field convertible auxiliary contact per overload relay.

c. Minimum of 1 N.O. field convertible auxiliary contact per cubicle breaker/disconnect.

8. Features:
   a. Provide control devices, relays, and contacts to perform the operations as specified in the Contract Documents.
   b. At a minimum provide the following on the enclosure door, unless specified otherwise in the contract documents:
      1) Run (green) pilot light.
      2) Failed (red) pilot light.

B. Overload Relay:
   1. NEMA ICS; three-phase bimetal with external manual reset.
   2. Class protection as recommended by the manufacturer of the motor it is protecting.
   3. Coordinate size with actual motor full load current.

C. Combination Full-Voltage Non-Reversing (FVNR) and Reversing (FVR) Magnetic Motor Starters:
   1. Full voltage, across the line, electrically held.
   2. Comply with NEMA ICS 2, general purpose, Class A.
   3. Line-voltage, magnetic starter with overload element and lockable motor circuit protector installed in common plug-in unit for control of induction motors.
   4. Motor circuit protector breaker with lockable handle.

D. Disconnecting Means and OCPDs:
   1. MCP Disconnecting Means:
      a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
      b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
      c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
      d. Auxiliary contact that operates only when MCP has tripped.
      e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

2.4 WALL MOUNTED MAGENTIC STARTERS

A. Shall be in accordance with the applicable requirements of the Motor Starters paragraph above.

B. Provide combination type with non-fusible disconnect switch, unless noted otherwise.

C. NEMA rated enclosure:
   1. Interior in conditioned space: NEMA 1 or NEMA 12.
   2. Outside, near a water source, or unconditioned space: NEMA 3R
      a. Provide bolt-on hub kit(s) for conduit connections to maintain NEMA 3R rating.
   3. Corrosive areas: NEMA 4X 316 stainless steel, unless noted otherwise.
   4. Class 1, Division 1, or 2 hazardous locations: NEMA 7 and listed as "Raintight".

D. UL Listed.

E. Manufacturer:
   1. Allen-Bradley.
   2. Cutler-Hammer.
   3. Square-D.
   4. ABB.

2.5 MANUAL MOTOR STARTERS

A. Manual starters shall be provided to control and protect 120-volt, single phase motors. They are identified on the Drawings as “MS.”

B. Starters shall be 120-volt, single pole with overload heater sized for the motor nameplate current.

C. The starter shall be mounted in a 2-gang FD box with single gang openings.

D. Cover:
   1. ON-OFF operator cover.
   2. Non-corrosive area.
      a. Appleton FSK-1VS, Crouse-Hinds DS199, or equal.
   3. Corrosive area:
      a. Non-metallic enclosure, toggle lever operator, and threaded hubs.
      b. Crouse Hinds NFSC2, or equal.

E. Manufacturer:
   1. General Electric CR101Y.
   2. Cutler-Hammer MS.
   3. Square D FG5.
   4. Or equal.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive equipment with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Coordinate layout and installation of equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Examine enclosures before installation. Reject enclosures which are wet, moisture damaged, or mold damaged.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install equipment in accordance with the NEC, as shown on the Contract Documents, and as recommended by the manufacturer.

B. Install fuses if not factory installed.

C. Install equipment in accordance with manufacturer's instructions.

D. Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and electronic overload relay pickup and trip ranges.

F. Program variable speed motor controllers per the manufacturer's instructions and in coordination with other trades so that a complete and functional system is delivered.

G. Adjust trip settings of circuit breakers and motor circuit protectors with adjustable instantaneous trip elements. Initially adjust at six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficiency motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

H. Install wiring between equipment and remote devices as specified and as required for the control specified in other sections.

I. Bundle, train, and support wiring in enclosures.

J. Manual motor starters shall be mounted near the equipment they serve where shown on the Drawings.

K. Connections and equipment settings shall be made to provide the operation specified in other specifications, including but not limited to Divisions 22 and 23.

L. Program equipment for required operational sequences, status indications, alarms, event recording, and display features.

M. An authorized service person with knowledge of the supplied VFD and/or SSRV shall perform the following before energizing the equipment:
   1. Set all parameters and setting of the device.
   2. Check the units for correct installation and field connections.

N. After the equipment has been energized, an authorized service person with knowledge of the supplied controller, motor, and project control equipment shall perform the following:
   1. Make all final settings and parameter adjustments.
   2. Adjust controls and signals with coordination of the supervisory control system programmer.

3.3 FREE STANDING EQUIPMENT INSTALLATION

A. Anchor the equipment with rustproof bolts, nuts, and washers not less than 0.5-inch diameter, in accordance with manufacturer's instructions, and as shown on drawings.

B. Install equipment level and plumb.

C. Interior Location. Mount equipment on concrete slab. Unless otherwise indicated, the slab shall be at least 4 inches thick. The top of the concrete slab shall be approximately 4 inches above the finished floor. The edges above floor shall have 0.5-inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut and bush conduits 3 inches above slab surface

3.4 VARIABLE FREQUENCY DRIVE INSTALLATION

A. The contractor shall evaluate proposed conduit runs containing conductors to and from a VFD to reduce possible harmonic or VFD noise interference with other circuits. Such conduits shall be run perpendicular to other conduits wherever possible.

B. VFD conduits shall be separate as far as possible, or a minimum of 12-inches from other equipment and conduits containing circuits for sensitive equipment/instrumentation such as meters, level monitors, signaling circuits, network/communication cabling, supervisory control equipment, etc.

3.5 OVERLOAD PROTECTION

A. Before any motor is energized, Contractor shall obtain the nameplate information from the motor supplier. The nameplate current of all motors shall be recorded in the O&M manuals. Where a one-line diagram is provided, record the full load ampere rating in the space under the motor labeled as "FLA_____."

B. Overload relays shall be checked for correct class and setting in accordance with motor manufacturer's recommendations. Class 10 overload relays shall be provided unless the motor manufacturer specifies otherwise.

C. Motor overload settings shall be in accordance with the starter manufacturer's recommendation for the given motor nameplate current, service factor and power factor correction capacitors, if provided. Contractor shall be responsible for all damage that results from improper overload protection.

D. Adjust overload relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

3.6 FIELD QUALITY CONTROL

A. Engage a representative or Contractor personnel trained on the provided equipment to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Inspect controllers, wiring, components, connections, and equipment installation.
   2. Test and adjust controllers, components, and equipment.
   3. Test continuity of each circuit.

4. Verify that voltages at controller locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager and Owner before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace them with new units and retest.
7. Test and adjust controls, remote monitoring, and safety features. Replace damaged and malfunctioning controls and equipment.
8. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.

C. Enclosed controllers will be considered defective if they do not pass tests and inspections.

D. Each controller shall be operated at rated load. Duration of the load test shall be as directed by the Engineer or Owner and as determined by the operating conditions of the installation.

E. Each unit with adjustable parameters shall be set to provide sufficient starting torque for the pump/motor to begin rotation when it is called for.

F. Clear events memory after final acceptance testing and prior to Substantial Completion.

G. Prepare test and inspection reports, including a signed report that identifies enclosed controllers and that describes testing results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.7 DEMONSTRATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the equipment is in good operating condition and properly performing the intended function.

3.8 TRAINING

A. Furnish the services of a competent, factory-trained engineer or technician for a 2-hour period, minimum, to instruct Owner personnel in operation and maintenance of the equipment, including review of the operation and maintenance manual, on a date requested by the Owner.

3.9 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components.

B. Provide warning signs as required by the NEC and when noted in the specifications.

C. Label MCC and each cubicle with engraved nameplate.

D. Label each enclosure-mounted control and pilot device.

E. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return it to manufacturer for inclusion in Record Drawings.

END OF SECTION

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SECTION 26 24 20 - ELECTRIC MOTORS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The electric motors furnished with all equipment shall conform to this specification. If a conflict exists between provisions of this section and provisions of other sections detailing the driven equipment, the provisions of this section shall govern.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical Division 26

B. All equipment Specifications from all Divisions, as applicable.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards: ANSI/NEMA MG1, MG2 - Motors and Generators.

1.4 CONTRACTOR SUBMITTALS

A. Complete motor data shall be submitted with the driven machinery shop drawings. Motor data shall include:

1. Machine name and specification number of driven machine.
2. Motor manufacturer.
3. Motor type or model and dimension drawing.
4. Nominal horsepower.
5. NEMA design.
6. Frame size.
7. Enclosure.
8. Winding insulation class and treatment.
9. Rated ambient temperature.
10. Service factor.
11. Voltage, phase, and frequency rating.
12. Full load current at rated horsepower for application voltage.
13. Starting code letter, or locked rotor kVA, or current.
14. Special winding configuration such as part-winding, star-delta.
15. Rated full load speed.
16. Power Factor at full load.

B. If water cooling is required for motor thrust bearings, the shop drawing submittals shall indicate this requirement.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Electric motors driving identical machines shall be identical.

B. The nominal motor horsepower shall be adequate for the driven machine without infringement upon the motor service factor.

C. Minimum Motor HP: The motor horsepower shall be not less than the estimated minimum specified for each driven machine. If the estimated minimum horsepower specified is not adequate to satisfy the foregoing restriction or any other requirements of these Specifications, the motor with the next larger horsepower shall be supplied at no additional cost to the OWNER. In addition, any changes caused by increase in motor horsepower shall be made by the CONTRACTOR at no additional cost to the OWNER; such changes may involve circuit breakers, magnetic starters, motor feeder conductors and conduit sizes, etc. This change shall be clearly noted in the submittal.

D. Exempt Motors: Motors which are for valve operators, submersible pumps, or motors which are an integral part of Standard Manufactured Equipment, i.e., non-NEMA mounting, common shaft with driven element, part of domestic or commercial use apparatus may be excepted from these Specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the specified driven equipment.

E. Motors operated using Variable Frequency Drives

1. Specifically designed for use with a solid-state inverter variable frequency drive (VFD).
2. Minimum service factor of 1.00 when operating from a VFD.
3. 1600V insulation system designed for inverter duty.
4. Shaft grounding ring on the drive end of the motor.
5. Insulated or insulated/ceramic bearing on the non-drive end of the motor for motors 100 hp and larger.

2.2 DESIGN REQUIREMENTS

A. Equipment requiring electric motors shall be equipped with motors conforming to the following, unless specifically noted otherwise.

1. The motor furnished shall have its design voltage inscribed on the nameplate.
2. All motors less than 30 HP shall be designed, constructed and tested in accordance with NEMA Standards MG1 and MG2.

B. Motors shall have current or up-to-date voltage ratings and shall be rated in accordance with the following, unless otherwise specified

1. Motors below 1/2-hp shall be rated 115 volts, single-phase, 60-Hz, unless noted otherwise on the plans. Dual voltage motors rated 120-240 volts are acceptable.
2. Motors 1/2-hp and larger shall be rated 230 volts, 3-phase, 60-Hz, as required and as shown on electrical drawings.

C. Single-Phase Motors shall be general purpose permanent split capacitor start, induction type, alternating current, constant speed, continuous duty, shall have a temperature rise of 115 degrees C based on a 40 degrees C ambient in accord with MG1-12.41, shall have service factor in accord with MG1-12.47, and shall be marked with a code letter. Fractional HP motors shall have NEMA frame size 42, 48, 56 or 66.

D. Three-Phase Motors 1/2 HP and larger but less than 30 HP:

1. Shall be general purpose, squirrel-cage induction type, alternating current, Design B, constant speed, continuous rated, shall have a temperature rise of 115 degrees C based on a 40 degree C ambient in accord with NEMA MG1-12.42, shall have a service factor of 1.15, and shall be marked with code letter.
2. Frame sizes shall be in accord with NEMA MG-1.

E. Three-phase motors 30 HP and larger:

1. Shall be general purpose squirrel-cage induction type, alternating current, NEMA Design B, constant speed, continuous rated, shall have temperature rise of 70 degrees C based on a 40 degree C ambient in accord with NEMA MG1-12.42, shall have a service factor of 1.15, shall have a starting KVA not exceeding that for Code F and shall be marked with a code letter.

2. Motors may be open drip-proof except where exposed to weather or otherwise specified.

   Motors through frame sizes 445 shall be of cast-iron construction. Larger frame sizes may be of welded steel.

F. Motor shall meet the following minimum efficiency values listed by NEMA for premium efficiency motors:

Motor Size (HP)	Totally Enclosed Fan Cooled (TEFC) and Explosion Proof (EP) Motors				Open Drip-Proof (ODP) Motors			
	RPM Levels				RPM Levels			
	900	1200	1800	3600	900	1200	1800	3600
1.0	77.0%	82.5%	85.5%	77.0%	77.0%	82.5%	85.5%	77.0%
1.5	80.0%	87.5%	86.5%	84.0%	78.5%	86.5%	86.5%	84.0%
2.0	85.5%	88.5%	86.5%	85.5%	87.5%	87.5%	86.5%	85.5%
3.0	85.5%	89.5%	89.5%	86.5%	88.5%	88.5%	89.5%	85.5%
5.0	87.5%	89.5%	89.5%	88.5%	89.5%	89.5%	89.5%	86.5%
7.5	88.5%	91.0%	91.7%	89.5%	91.0%	90.2%	91.0%	88.5%
10.0	91.0%	91.0%	91.7%	90.2%	91.7%	91.7%	91.7%	89.5%
15.0	91.0%	91.7%	92.4%	91.0%	91.7%	91.7%	93.0%	90.2%
20.0	91.7%	91.7%	93.0%	91.0%	92.4%	92.4%	93.0%	91.0%
25.0	91.7%	93.0%	93.6%	91.7%	92.4%	93.0%	93.6%	91.7%
30.0	93.0%	93.0%	93.6%	91.7%	93.0%	93.6%	94.1%	91.7%
40.0	93.0%	94.1%	94.1%	92.4%	93.0%	94.1%	94.1%	92.4%
50.0	93.6%	94.1%	94.5%	93.0%	93.6%	94.1%	94.5%	93.0%
60.0	93.6%	94.5%	95.0%	93.6%	94.1%	94.5%	95.0%	93.6%
75.0	94.5%	94.5%	95.4%	93.6%	95.0%	94.5%	95.0%	93.6%
100.0	94.5%	95.0%	95.4%	94.1%	95.0%	95.0%	95.4%	93.6%
125.0	95.0%	95.0%	95.4%	95.0%	95.0%	95.0%	95.4%	94.1%
150.0	95.0%	95.8%	95.8%	95.0%	95.0%	95.4%	95.8%	94.1%
200.0	95.4%	95.8%	96.2%	95.4%	95.0%	95.4%	95.8%	95.0%

2.3 MOTOR BEARINGS

A. General: Bearings shall conform with the provisions of Section 11000, “Equipment General Provisions”, except as supplemented or modified by the requirements of this Specification.

B. Standard Duty: Unless otherwise specified, all motors shall be suitable for standard duty with a minimum bearing life of 5 years or 20,000 hours (B-10 rating), whichever comes first.

C. Heavy Duty: Where equipment is specified for heavy duty service, bearings shall be designed for a minimum rated B-10 life of 10 years or 40,000 hours, whichever comes first.

D. Fractional Horsepower: Fractional horsepower through 2 hp motors shall be furnished with Lubricated-for-Life ball bearings.

E. Horizontal Motors Over 2 hp: Motors larger than 2 hp shall be furnished with relubricatable ball bearings, except vertical pump motors.

F. Vertical Motors Over 2 hp: Vertical motors larger than 2 hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

G. Water-Cooled Motors: If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve and, (where subject to freezing), insulation with heat tracing.

2.4 ACCESSORY REQUIREMENTS

A. Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes.

1. Motors other than open drip-proof shall be gasketed.

B. All motors weighing 265 lb (120 Kg) or more shall have suitable lifting devices for installation and removal.

C. The Contractor shall refer to individual equipment specifications for special requirements such as motor winding thermal protection, multi-speed windings, etc.

D. Unless otherwise shown, all motors mounted outdoors which are 25 hp and larger shall be furnished with belted space heaters. Space heater rating shall be 120 volts, single-phase, unless otherwise shown.

E. All motors shall be fitted with a permanent, non-corrosive nameplate indelibly stamped or engraved with NEMA Standard motor data, including bearing description and lubrication instructions. Insulation class, ambient temperature, altitude rating, and power factor at full load, if applicable, shall be included.

2.5 MANUFACTURER

A. The Contractor shall assign to the designated equipment supplier the responsibility to select and supply suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to favorable review by the Engineer. Such review will consider future availability of replacement parts and compatibility with driven equipment.

B. Manufacturers, or Equal:

1. General Electric Company;

2. U.S. Motors Corporation;

3. Marathon

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.

B. Electrical work involving connections, controls, switches, disconnects, etc., shall be performed as provided in the applicable Sections of Division 26.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. Lighting Control Devices.

B. Convenience receptacles.

C. Data jacks.

D. Wall plates.

1.2 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

B. Submittals for pre-approval shall be submitted 2 weeks prior to the bid date. Manufacturers of equipment looking for approval shall schedule a demonstration meeting at the Engineer's office to demonstrate the capabilities and quality of the devices. This meeting shall be scheduled 2 weeks prior to the bid date. Manufacturer/Contractor is responsible for scheduling around Engineer's prior engagements.

1.3 QUALITY

A. All wiring devices shall be products of the same manufacturer, unless specifically noted otherwise.

1.4 DEVICE COLORS

A. Wiring devices mounted on or flush to a finished ceiling shall match the color of the ceiling.

PART 2 -- PRODUCTS

2.1 LIGHTING CONTROL DEVICES

A. Switches:
   1. Heavy-duty, specification grade.
   2. Quiet, toggle type.
   3. Side and back wired.
   4. Rated 20 amperes under all loads, 1 HP at 120 volts, 2 HP at 240 volts.
   5. Single-pole, 2-pole, 3-way and/or 4-way as shown on the Drawings.
   6. Approved Manufacturers:
      a. Cooper.
      b. Hubbell.
      c. Leviton.
      d. Pass & Seymour.
      e. Lutron.

B. Occupancy/Vacancy Sensors, Ceiling Mount:
   1. Dual sensing technologies, including passive infrared and either ultrasonic or sound detection.
   2. Sensor shall be designed so the use of the dual technologies activates the sensor without erroneous activations and detection of occupancy by either technology shall hold the lights on.
   3. 30-second to 30-minute adjustable time delay to turn off lights.
   4. Dense, wide angle coverage pattern.
   5. UL listed for use of line voltage or low voltage systems.
   6. Provide dry contacts internal to the device and/or separate relay packs to perform the specified control.
   7. Provide all power supplies and mounting hardware.
   8. Single-pole, 2-pole, 3-way and/or 4-way to perform the specified lighting control.
   9. Approved Manufacturers:

a. Watt Stopper.
b. Sensor Switch.
c. Leviton
d. Lutron
e. Cooper
f. Hubbell.
g. Pre-approved equal.

C. Occupancy/Vacancy Sensors, Wall mount:
1. Dual sensing technologies, including passive infrared and either ultrasonic or sound detection.
2. Sensor shall be designed so the use of the dual technologies activates the sensor without erroneous activations and detection of occupancy by either technology shall hold the lights on.
3. 30-second to 30-minute adjustable time delay to turn off lights.
4. Dense, wide angle coverage pattern.
5. UL listed for use of line voltage or low voltage systems.
6. Provide dry contacts internal to the device and/or separate relay packs to perform the specified control.
7. Provide all power supplies and mounting hardware.
8. Single-pole, 2-pole, 3-way and/or 4-way to perform the specified lighting control.
9. Integral push button to override occupancy sensor controls:
a. Activation of button when lights are off shall turn lights on.
b. Activation of button when lights are on shall turn lights off.
c. Sensing technology shall control lights as specified above after a button has been pressed.
d. Provide device with multiple buttons for spaces with multilevel/step and/or multizone lighting.
10. Approved Manufacturers:
a. Watt Stopper.
b. Sensor Switch.
c. Leviton
d. Lutron
e. Cooper
f. Hubbell.
g. Pre-approved equal.

D. Exterior Photo Controls:
1. Light level selector to adjust activation.
2. Time-delay activation and de-activation.
3. Signal compatible with Exterior lighting equipment.

E. Low Voltage Dimmer:
1. For use in spaces with automated controls such as vacancy/occupancy detection, time of day and day light controls.
2. Provide solid state, suitable for mounting behind a standard depth faceplate and for operation on common neutral circuits.
3. Provide sufficient capacity dimmer to accommodate the connected load of the light fixtures controlled by the dimmer.
4. Suitable for single-pole, 3-way and 4-way switching.
5. Electrostatic discharge protection.
6. Pushbutton for on/off control.
7. Pushbutton for dimming up/down control.
a. Provide with preset feature to return lights to previous light level when turning the lights on.
8. Button function shall be identified with manufacturer engraving or similar means.
9. 0-10 volt or luminaire compatible control signal directly proportional to the desired light levels. Signal source method and control signal shall be coordinated with the controlled luminaires.
10. Approved Manufacturers:
a. Lutron.

b. Leviton.
c. Cooper/Arrow Hart.
d. Hubbell.
e. Pre-approved equal.

2.2 CONVENIENCE RECEPTACLES

A. Duplex receptacles:
1. Specification grade, 3-wire grounding type, NEMA 5-20R.
2. Side wired.
3. Rated 20 amperes, 125 volts.
4. In addition to when noted in the Contract Documents, tamper resistant devices shall be provided where required by the NEC and other governing codes.
5. Spring type grounding strap that holds mounting screws captive.
6. Approved Manufacturers:
a. Cooper.
b. Hubbell.
c. Leviton.
d. Pass & Seymour.

B. Ground Fault Circuit Interrupter Receptacles:
1. Specification grade, 3-wire grounding type, NEMA 5-20R.
2. Side wired.
3. Rated 20 amperes, 125 volts.
4. In addition to when noted in the Contract Documents, tamper resistant devices shall be provided where required by the NEC and other governing codes.
5. LED trip indicator.
6. Approved Manufacturers:
a. Cooper.
b. Hubbell.
c. Leviton.
d. Pass & Seymour.

2.3 HAZARDOUS LOCATION DEVICES

A. Switches:
1. Heavy duty, factory sealed, general use snap switches.
2. UL listed for Class 1, Division 1, Group C and D hazardous locations.
3. Approved Manufacturers:
a. Appleton EDS.
b. Crouse-Hinds EDS.
c. Or equal.

B. Receptacles:
1. 20 A, 125 to 250 Vac, 60 Hz.
2. 2 wire, 3 pole, single gang.
3. Aluminum receptacle housing and back box.
4. Furnish complete with matching plug.
5. UL listed for Class I, Division 1. Group C and D hazardous locations.
6. Approved Manufacturers:
a. Crouse-Hinds CPS/CPP.
b. Killark KRS.
c. Or equal.

2.4 DATA MODULAR JACKS

A. Provide data outlet devices with the following specifications:
1. Plastic modular 8 pin, 8-conductor outlet jack with insulation displacement connectors (IDC)
2. ANSI/EIA/TIA-568-B.2 Category 6A compliant.

3. T568B pin/pair wire map
4. Provide the following color scheme for outlet devices:
    a. Data Modular Jacks: Blue
    b. Approved Manufacturers:
        1) Leviton.
        2) Hubbell.
        3) CommScope/Uniprise.
        4) Pre-approved equal.

2.5 COVERPLATES

A. Interior Coverplates: Provide new cover plates over all boxes with the following minimum specifications:
    1. All finished areas and unfinished areas with recessed boxes: Provide type 302 stainless steel with smooth satin finish.
    2. Unfinished areas over surface mounted boxes:
        a. Surface mounted switches and receptacles in FS or FD cast device boxes provide raised metal cover to match the surface metal box.
        b. Surface mounted switches in cast aluminum boxes shall have stainless steel cover plates with dimensions which match the box dimensions.
    3. Provide appropriate covers for special purpose receptacles.

B. Exterior Coverplates: Provide weatherproof “while in use”, cover plates for outlets and switches as indicated in the Contract Documents.
    1. Provide weatherproof boots for all drop cords as indicated in the Contract Documents.
    2. Weatherproof switch cover plates: Cast aluminum or Lexan with cover and vinyl gasket for weatherproofing switch; or cast aluminum with lever and weatherproof gasket.
    3. Weatherproof receptacle cover plates: Specification grade, weatherproof, cover plate, gasketed corrosion resistant hood/cover rated for extra-duty, for exterior and wet area receptacles.
    4. Coverplates shall be NEMA 3R rated and shall be watertight when in use.
    5. Approved manufacturers:
        a. Red Dot
        b. Leviton
        c. Pass and Seymour
        d. Pre-approved equal

C. Wall plates for switches or manual starters which serve exhaust fans shall be engraved “EXHAUST FAN” with 1/8-inch-high black letters.

D. Chemical Rooms:
    1. Weatherproof covers for receptacles in chemical rooms shall have non-metallic double-lift cover plates.
    2. Weatherproof covers for switches in chemical rooms shall have non-metallic toggle-switch cover plates.

PART 3 -- EXECUTION

3.1 WIRING DEVICES

A. Provide new devices for all outlets indicated. Provide individual GFCI, isolated ground and surge suppression device for each duplex receptacle in ganged outlets.

B. Wire each device by wrapping the conductors around the terminals and torquing the screw terminal tight.

C. Mount all receptacles with the ground pin on the bottom.

D. Replace all receptacles and plates that have been damaged, burned or discolored during construction, prior to Substantial Completion.

E. Install wall plates after all the painting has been completed.

F. Mount wall mounted dimmers in separate boxes from switches.

G. Test all wiring devices for continuity, proper polarity connections and grounding.

H. Switches and convenience outlets shall be provided where shown on the Drawings.

I. Mounting Heights: dimensions are to the center of the outlet box:
   1. Switches shall be on the latch side of doors, located 4 feet above floor, unless noted otherwise.
      a. Door swing shall be verified with door installer before installing switch outlet boxes.
   2. Exterior receptacles shall be mounted at 2 feet above grade level, unless noted otherwise.
   3. Receptacle outlets in the finished area shall be mounted 18 inches above floor, unless noted otherwise.
   4. Interior surface mounted receptacles shall be mounted at 4 feet above floor level, unless noted otherwise.

J. For all receptacles to be installed above counters installed above counters or worktables shall be mounted with short dimension parallel to the floor. Contractor shall verify countertop heights before installing boxes for convenience receptacles.

K. All receptacle outlets shall be grounded to a separate grounding conductor that has green insulation.

L. All switches, convenience receptacles, telephone outlets, manual starters, etc. in the finished areas shall be flush mounted. Flush boxes shall fit flush with the final finished wall in every case. Install metal box extenders and bond to the box where necessary.

M. All boxes shall be plumb.

N. Where indicated in the Contract Documents as WP, switches and receptacles shall have weatherproof cover plates.

O. All receptacles on a GFCI breaker shall be identified with laminated plastic nameplates which read: “GFCI PROTECTED.” Letters shall be 1/4-inch-high white on a red background. Feed through type GFCI receptacles which feed non-GFCI type receptacles when shown as GFCI type receptacles on the Contract Documents are not allowed, unless noted otherwise.
   1. For double-duplex and other multi-gang receptacles, one of the receptacles is to be a GFCI type receptacle and the remaining receptacles in the shared box may be fed through.

P. Contractor shall be responsible for providing GFCI and Arc fault protection where required per the NEC. Not all instances may be shown on the Contract Drawings. Protection may be provided either via an accessible wall device or a rated breaker at the feeding panelboard. Installation of a blank wall device with protection features to feed devices without the protection features will not be allowed, unless specifically noted in the Contract Documents.

3.2 OCCUPANCY AND LIGHT LEVEL SENSORS

A. Where occupancy sensors, daylight, or photocell sensors are to be used, Contractor shall provide a guarantee of sensor coverage and operation for the Contractor’s proposed sensors and layout. It is the responsibility of the Contractor to work with the proposed manufacturer or product representative to determine sensor layout and quantities. The indicated sensor layout in the Contract Documents shall be revised to meet the manufacturer’s recommended layout and sensor locations to achieve the guarantee of sensor coverage and operation.

B. If the Owner has a nuisance tripping problem for any lighting zone controlled by such sensor it is the Contractor’s responsibility to resolve the issue. Contractors shall adjust the sensor settings such as sensitivity levels and time delays.

C. If it is determined the sensor is in a troublesome location such as mounted to close to windows, grills, HVAC equipment, fans, etc. The contractor shall move the device to a new location as recommended by the manufacturer.

1. Occupancy/Vacancy sensors shall not be mounted 4’ or closer to heaters, diffusers, air returns and other mechanical equipment.

D. Where it is determined the quantity of supplied sensors is not sufficient, Contractor shall add additional sensors to offer the specified control without erroneous tripping, false offs or slow activations.

E. If it is determined by Owner and Engineer the model or type of sensor provided is inadequate for the space usage or is unable to provide the specified control, Contractor shall replace the sensor(s) with a different model and/or manufacturer at request of Owner at no additional cost. If additional sensors are needed to provide the adequate coverage per the new manufacturer or model recommendations, Contractor shall install the additional sensors at no additional cost to Owner.

F. All sensor work shall be included in the bid/quote amounts. Contractors will not be awarded additional services to perform troubleshooting, programming, installations, repairs, relocations, etc. or any other work associated to the sensing devices in relation to delivering the specified lighting controls.

3.3 SPECIAL-PURPOSE RECEPTACLE IDENTIFICATION

A. Provide engraved phenolic nameplates for all special-purpose receptacles, including but not limited to chemical pump control receptacles, split-controlled (part-switched) receptacles, and any receptacle where all or a portion of the device is switched, relay-controlled, or process-controlled.

B. Nameplates shall clearly identify the receptacle function or operating mode. Where the device is split, the controlled and constant portions shall each be identified separately (e.g., "CHEM PUMP — CONTROLLED" and "CONSTANT POWER").

3.4 COVERPLATE IDENTIFICATION

A. Provide ¼” high engraved, black-infilled lettering laser etching engraved cover plates.
1. This requirement is for all receptacle and lighting devices.

B. Provide identification on the plate immediately above the wiring device on the backside of the cover plate, unless noted otherwise.

END OF SECTION

SECTION 26 28 16 - SAFETY SWITCHES

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. Safety Switches

B. Enclosed Circuit Breaker

C. Installation

1.2 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.
   1. Safety Switch type, size, rating, enclosure type, switches poles, solid poles, HP rating
   2. Fuse size and type (if fused)
   3. Identification tag/nameplate

PART 2 -- PRODUCTS

2.1 SAFETY SWITCHES (DISCONNECT SWITCHES)

A. General requirements
   1. Provide safety switches as disconnects for all utilization equipment as indicated on the Drawings in addition to as required by the governing codes.
   2. Provide lockable handle with multiple hasps to allow proper lockout-tagout procedures.
   3. Provide NEMA 3R enclosures when mounted outside. Provide bolt-on hub kit(s) for conduit connections in order to maintain NEMA 3R rating.
   4. NEMA 7 and listed as "Raintight" for switches installed in Class 1, Division 1, or 2 hazardous locations.
   5. Unless specifically noted otherwise, provide 3-pole with solid neutral bus for landing line and load side neutral conductors.
   6. Provide proper size and quantity of lugs to terminate all phase conductors and neutral conductor. Neutral conductors may require more lugs, and a larger size.
   7. Provide interior ground lug.

B. Fused or unfused switch type:
   1. Provide heavy duty switch with quick-make, quick-break mechanism with positive interlock.
   2. Hinged door with mechanical interlock in the ON position, with defeat mechanism.
   3. Provide horsepower rated disconnects, fully rated for load-break and load-make operation.
   4. Provide service entrance rated switches where required.
   5. Approved manufacturers:
      a. Cutler-Hammer DH series
      b. General Electric TH series
      c. Square-D Class 3110 series
      d. Allen Bradley 1494 series
      e. Pre-approved equal.

C. Corrosive locations:
   1. NEMA 4X non-metallic enclosure.
   2. Suitable for use as motor disconnect.
   3. Lockout/tag out capabilities.
   4. Round selector handle.
   5. Approved Manufacturers:
      a. Mersen.
      b. Or Equal.

2.2 ENCLOSED CIRCUIT BREAKERS

A. Units consisting of molded case circuit breakers individually mounted in enclosures.

B. Lockable handle with multiple hasps to allow proper lockout-tagout procedures.

C. NEMA 1 or 12 enclosure when mounted inside.

D. Unless specifically noted otherwise, provide 3-pole with solid neutral bus for landing line and load side neutral conductors.

E. Service entrance rated switches when required.
   1. Solidly bonded equipment ground bus with suitable lugs for terminating each equipment grounding and bonding conductor.

F. Provide proper size and quantity of lugs to terminate all phase conductors, neutral conductor, and surge protection device. Neutral conductors may require more lugs, and a larger size.

G. Provide interior ground lug.

H. 100-percent rated electronic trip, molded case:
   1. The operating mechanism shall be quick-make, quick-break with provisions for padlocking in the open position.
   2. True RMS sensing.
   3. Adjustable settings for
      a. Long-time pickup.
      b. Long-time delay.
      c. Short-time pickup.
      d. Short -time delay.
      e. Instantaneous pickup.
      f. Ground fault tripping
      g. Ground fault pickup.
      h. Ground fault delay.
   4. Long time and ground fault memory.
   5. Trip indicators for overload, short circuit, and ground fault.

I. Approved Manufacturers:
   1. Eaton
   2. ABB
   3. Square D.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Install safety switches with operator handle no higher than 6’-7” above finished floor in front of the safety switch unless otherwise allowed by the NEC.

B. Mount safety switch as close to the equipment as possible. Provide unistrut rack if necessary.

C. Do not mount safety switches on removeable panels on the equipment served. Coordinate location of safety switches with the equipment provider prior to installing the switch.

D. Install safety switches with proper working clearances about the switch.

E. Disconnects for single-phase motors shall be manual motor starters or manual motor starting switches as specified in the Contract Documents.

3.2 IDENTIFICATION

A. Provide an engraved or laminated plastic nameplate on each switch. Label per the name of the device controlled unless noted otherwise on the plans.

END OF SECTION

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes
   1. Outdoor Diesel engine driven generator.
   2. Receptacles, cables, and other accessories as specified.

B. Related Sections
   1. Division 26.

1.2 REGULATORY REQUIREMENTS

A. Equipment shall conform to the following:
   1. OSHA
   2. Environmental Protection Agency.
   3. Governing Pollution Control Agency.
   4. National Electrical Code (NFPA 70).

1.3 SUBMITTALS

A. Submit the following items consistent with Section 26 05 00:

B. The following information shall be included with each submittal:
   1. Engine-generator assembly base dimensions, unit enclosure dimensions, equipment weights and loading data. This information shall include detailed dimension and weight data for the generator silencer and exhaust stack (where applicable).
   2. Drawing(s) showing the general arrangement and dimensions of the engine generator unit and the outdoor enclosures (where applicable). Include location of all auxiliary system component connections and engine-mounted equipment.
   3. Catalog cut sheets on generator assembly including major on and off-engine auxiliary components (those items not integral with the manufacturer's package purchased from other vendors) indicating size, capacity, performance, design data, materials of construction and operating conditions. If catalog data is not available, include a Bill of Materials for the equipment proposed and all available data.
   4. Provide locations of and specifications/dimensions for all required field connections to generator assembly.
   5. Provide guaranteed fuel rate data for engine operation. Fuel rates shall include operation at 50 percent, 75 percent and 100 percent of design rated net Standby Power output in kW.
   6. Provide guaranteed emission data. Provide supplemental information on other pollutants that are regulated by the governing environmental control agency relevant to this project.
   7. Detailed schematic wiring diagrams showing Automatic Transfer Switch (ATS) wiring terminations, SCADA monitoring terminations, and all other internal and external wiring terminations. Drawings shall be developed custom for this project. Terminal numbers shall be coordinated and reflect the actual terminal numbers used at the ATS and SCADA control panels.
   8. Cable/plug assemblies.
   9. Color chips for enclosure.
   10. Certified copies of factory production test results.

C. Operation and Maintenance Manual
   1. The following information shall be included:
      a. Include all the information provided with the shop drawings and manufacturer's information.
         1) Update and complete control system drawings and descriptions for all equipment.
         2) All documentation shall include modifications made which reflect the final installation.
      b. Operating instructions.
      c. Maintenance information.
      d. Recommended spare parts list with pricing.

e. Accurate wiring diagrams for trouble shooting purposes.
f. Manufacturer's literature on all equipment and systems.
g. Name, address, phone number of manufacturer's local representative and maintenance facility.
h. Warranty information.
i. Copy of test results and certifications.

1.4 DESIGN CRITERIA

A. Ratings shall be for service at 60 Hz, 3-phase, 4-wire, 480/277-volts, and 0.80 power factor.

B. Engine-generator shall have minimum nominal standby electrical output ratings as described below.

C. Each engine-generator shall be capable of carrying 110 percent of rated net Prime Power output at a 0.80 power factor for two hours out of any 24-hour period.

D. All ratings shall be based upon the equipment located at an elevation of 1,000 feet above sea level.

E. Engine-generator shall be sized by the manufacturer to operate the required loads, however, engine-generator assembly shall have a standby power output rating of not less than 600 kW without written approval of Engineer.
1. Refer to the Drawings for HP of each motor and the associated motor controller to be used.
2. Instantaneous voltage drop shall not exceed 20 percent as measured at the main switchboard assembly at any time.
3. Instantaneous frequency dip shall not exceed 10 percent as measured at the main switchboard assembly at any time.

F. Each engine-generator unit shall be emissions certified for the calendar year in which it is installed. Guarantees are to be provided for verification of allowable emission levels for pollutants that are regulated by the governing environmental control agency relevant to this project.

1.5 FACTORY TESTS

A. All system components and hardware necessary for complete and fully functional standby generation systems shall be factory tested as complete assemblies prior to installation at the project site. These tests shall include, in addition to "standard" factory tests, additional testing as described below.

B. Factory production tests shall be conducted, certified, and documented by Contractor. Tests shall be performed at rated standby load and at 0.8 power factor in accordance with NFPA 110. These tests shall include, but not be limited to
1. Steady state voltage and frequency analysis.
2. Transient response.
3. Maximum power output analysis.
4. Supplier's standard factory engine tests.
5. Supplier's standard factory generator tests.
6. Safety shutdowns.
7. Hydrostatic test of radiator and oil cooler.
8. Continuity test and insulation resistance on electrical power and control system components and circuits. Do not include in these tests any device or equipment not design to withstand an insulation resistance test.
9. 100-percent prime rating block load acceptance test per NFPA 110.
10. Load carrying capability tests:
    a. 1 hour at 100-percent prime rated net output (0.8 p.f.).

C. Data points to be approved by Engineer before testing of engine commences.

D. Contractor shall give Engineer a minimum of 2-weeks advanced notice of scheduled testing of engine-generator so that Engineer and/or Owner may observe testing.

E. The Owner shall retain all copyrights to the test data.

F. Test result data shall be submitted to the Engineer for approval before the generator assembly is released for delivery to the project site.

1.6 FIELD LOAD BANK TEST

A. Provide a 2-hour field load bank test at 100 percent of standby rating.

B. Record beginning fuel level, ending fuel level, KW load, output voltage, output current, oil pressure, water temperature, and ambient temperature at 15-minute intervals throughout the test.

C. Include copies of the load bank test in each O&M manual.

1.7 WARRANTY

A. The Contractor shall be held responsible for any and all defects in workmanship, materials and equipment that may be found in any part of the engine-generator assemblies. Contractor shall immediately replace and make good without expense to the Owner any such faulty parts and damage done by reason of same, during the period of 5 years or 3,000 machine hours, minimum, from the date of final project completion.

B. Where installed materials and/or equipment carry a manufacturer's warranty for a longer period; the generator assembly supplier shall, at no additional cost to Owner, replace any and all parts that fail during the manufacturers' warranty periods.

C. All warranties shall be comprehensive covering parts and labor. No deductibles or costs shall be allowed for travel time, service hours, repair parts, tools, etc.

D. Should the Contractor fail to make good the defective parts within 30 days of such notifications, Owner may replace these parts charging the expense, including labor, to the Contractor.

PART 2 -- PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Acceptable Manufacturers are as follows:
1. Caterpillar.
2. Cummins.
3. MTU Detroit Diesel.
4. Kohler.

2.2 DIESEL ENGINE

A. Multi-cylinder, 4 cycle, diesel for Standard No. 2 diesel fuel turbo charged.

B. Engine shall be certified to meet all required EPA and governing environmental control agencies air emission limits.

C. Rated horsepower sufficient to drive the generator at rated kW.

D. Water cooled, thermostatically controlled utilizing an engine mounted radiator with flanges for duct connections. Provide a readily accessible and viewable overflow tank.

E. Pressurized circulating lube oil system complete with filtering system.

F. Crankcase breather kit.

G. Heavy duty, dry element type air cleaner with restriction indicator.

H. Electric isochronous governing system.

I. DC starting motor capable of cranking engine at starting speed for a duration of at least 30 seconds.

J. Battery charging alternator.

K. Sub-base fuel tank for 24 hours of operation at full load.
1. Full load bearing structural base with integral fuel cell. Fuel cell shall be dual wall, constructed of 12-gauge steel.

2. Readily accessible level gauge, rupture alarm, supply line, return line, vent, fill fittings on top of tank, and drain line on side.
3. Fuel containment area shall be supplied with a leakage alarm and a minimum of 2 alarm contacts. Alarm shall not shut down the generator automatically.
4. Readily accessible manual shut off valves for supply and return lines.
5. Primed and painted exterior finish
6. Low fuel level alarm contacts (2).
7. Tank shall be UL listed and shall meet spill containment requirements of the Environmental Protection Agency and the State of Minnesota.

L. Vibration isolation dampers between engine/generator and fuel tank.

M. Vibration isolation dampers between base of generator assembly and concrete pad.

N. Clear access shall be provided to all filters and to the oil drain to facilitate on site maintenance.

2.3 GENERATOR

A. Synchronous machine with brushless revolving field.

B. 480-volt, 3 phase, 4 wire windings.

C. The generator neutral point shall be bonded per NEC requirements.

D. Separately excited generator that uses a separate permanent magnet generator (PMG) to power the voltage regulator.

E. Automatic static voltage regulator that senses all 3 phases to regulate output voltage from no load to full load within 0.5 percent, and shall include under-frequency protection.

2.4 BATTERY AND CHARGER

A. Lead acid battery.

B. Sufficient amp-hour rating to match cyclic starting control for a minimum of 3 cranking cycles.

C. Automatic standby battery charger with dual charging rates and charging DC ammeter.

D. Charger shall disconnect either during starting or operation.

E. The battery package shall be complete with cables and hardware.

F. Charger shall be mounted within the generator assembly footprint.

2.5 COLD WEATHER PACKAGE

A. Provide a cold weather package which consists of the following:
1. 60A, 120/240V, NEMA 3R load center rated for 10kAIC with the following breakers:
   a. GFCI Receptacle
   b. Battery Charger
   c. Jacket Water Heater
   d. Alternator Heater
   e. Dampers (if 120V or 240V rated)
2. Louvers with dampers, and thermostat controlled damper actuators.
3. Jacket water heater to maintain engine block at 100 degrees F to assure rapid starting.
   a. Provide disconnect/automatic sealing couplers to isolate the heater for replacement of the heater element.
   b. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
4. Alternator heater.

B. Equipment at the generator shall be prewired by the Manufacturer.

C. Coordinate location of load center and entrance for feeder conductors with Contractor.

D. Contractor is responsible for ensuring all equipment is wired, either Contractor provide all conduit/wire in field to devices and equipment or all equipment to be provided pre-wired by manufacturer.

2.6 CONTROL PANEL

A. Manufactured to minimize field wiring and terminations. Locate so all controls, gages, and meters are readily accessible from the floor or ground. Top of control panel shall not exceed 6'-6" above the floor, ground or catwalk.

B. Contain all engine and generator controls, meters, switches, and annunciator indicators.

C. Control panel lamps shall be provided for night time viewing.

D. Panel shall be mounted on vibration isolators.

E. Control Provisions:
   1. Generator set controller shall have a graphical display with positive image, transflective LCD, and adjustable backlight/contrast.
      a. Graphical display shall display at a minimum: modes of controls, alarms and generator status, and electrical measurements.
   2. Automatic cyclic engine start controller which will start or stop generator under the control of an automatic transfer switch.
   3. Mode selector switch which is capable of selecting automatic, manual, off, and lock-out modes.
   4. Voltage adjust potentiometer to regulate voltage manually in the range of ± 5 percent.
   5. Emergency Stop pushbutton switch.
      a. If switch is located on exterior of enclosure, generator shall initiate a common alarm output contact.
   6. Safety shutdown controls and alarm notification for the following:
      a. Low oil pressure.
      b. High coolant temperature.
      c. Overspeed.
      d. Overcrank.
      e. Activation of Emergency Stop switch.
      f. Low coolant level.
   7. The following features, at a minimum, shall be provided at the panel:
      a. Alarm horn with Alarm acknowledge button.
      b. Auto/Start(Run)/Stop buttons or switch.
      c. Engine Running notification.
      d. Engine cool down timer.
      e. Low oil pressure warning alarm.
      f. High coolant temperature warning alarm.
      g. Failure to start alarm.
      h. Overspeed warning alarm.
      i. Over crank warning alarm.
      j. 25% Low fuel level alarm.
      k. Fuel tank full notification.
      l. 75% fuel level warning.
      m. 50% fuel level warning.
      n. Rupture basin alarm.
      o. Charger fail (low battery voltage) alarm.
      p. Low coolant temperature alarm.
      q. System ready notification.
   8. Provide isolated SPDT contacts for remote monitoring:
      a. Provide a contact for common alarm, generator ready status, 25% low fuel alarm, 75% fuel level warning, 50% fuel level warning and generator running signals.
   9. At a minimum, provide the metering devices as required for the following, each point shall be displayed on the control panel graphical interface:
      a. Generator AC Voltage - 3 phase (L-L & L-N).

b. Generator AC Current (per phase & average).
c. Generator Power kW (total & per phase).
d. Generator kVA (total & per phase).
e. Generator kW-hr (total)
f. Generator Frequency.
g. Generator Power Factor (average & per phase)
h. Battery Voltage.
i. Engine Hours.
j. Engine RPM.
k. Engine Oil Pressure.
l. Engine Coolant Temp.
m. Engine Crank Attempt Counter.
n. Service Maintenance Interval (Engine Operating Hours and Calendar Days)
o. Real Time Clock
p. Twenty Event Fault Log.

F. Overload protection
1. 100-percent rated electronic trip, molded case:
a. The operating mechanism shall be quick-make, quick-break with provisions for padlocking in the open position.
b. True RMS sensing.
c. Adjustable settings for
1) Long-time pickup.
2) Long-time delay.
3) Short-time pickup.
4) Short -time delay.
5) Instantaneous pickup.
d. Interchangeable rating plugs.
e. Thermal magnetic backup protection.
f. Long time and ground fault memory.
g. Trip indicators for overload, short circuit, and ground fault.
h. Ground fault test provisions and form C contact for remote alarm.
i. Approved Manufacturers:
1) Cutler-Hammer
2) General Electric
3) Siemens
4) Square D.
2. The circuit breaker(s) shall be identified with engraved phenolic nameplates which have white lettering of not less than 3/16 inch on a black background. Nameplates shall be attached with stainless steel screws.

2.7 SILENCERS

A. "Residential Grade" silencer.

B. Attenuation of 30 decibels in the 100 to 250 Hz range, 22 decibels above 4,000 Hz.

C. Mounted above the generator set.

D. Silencer shall have a single package, modified silicone finish applied over an inorganic zinc prime coat. Finish shall withstand continuous temperatures of 538 degrees C (1,000 degrees F.), surges up to 649 degrees C (1,200 degrees F), and thermal shock from 538 degrees C to 0 degrees C; Carboline 4631, or approved equal. Primer shall be Carboline Carbo Zinc 11, or approved equal.

2.8 SOUND ATTENUATING WEATHERPROOF HOUSING

A. Operating handles for latching the panels shall be lockable. 2 sets of keys shall be provided.

B. All metal parts shall be cleaned, primed, and painted with a durable, weather-resistant, semi-gloss, baked enamel finish.

C. Stainless steel hinges.

D. Bird / rodent screens over intake and exhaust louver opens. Screen openings shall be no larger than ¼ inch.

E. Adequate size to contain the engine-generator set and all accessories including the silencer.

F. Oil/moisture resistant acoustical insulation.

G. Provide steel cage around exhaust discharge to prevent vandalism.

H. Sound performance at rated load; 75dBA at 7 meters.

2.9 SPARE PARTS

A. Block heater

B. Air filter.

C. Fuel filter.

D. Oil filter.

E. Fuses (2 of each type used in generator set).

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The engine generator set shall be installed compete with all accessories.

B. Contractor shall provide generator grounding as per NEC.

C. Anchor the engine generator set to the concrete pad with stainless steel anchor bolts.

D. Provide cover plates (painted to match the skid) to cover any openings in the enclosure and / or skid.

E. Rodent proof the installation by sealing all openings and gaps.

F. Contractor shall notify Owner and Engineer 2-weeks prior to mounting anxilary devices such as receptacles, lighting, cable storage boxes, to the portable generator assembly to allow coordination of equipment location with Owner.

3.2 FULL FLUID RESERVOIRS

A. The batteries, radiator, crankcase, and any other reservoir shall be filled as part of this Contract.

B. Owner will provide fuel for generator.

3.3 TESTING

A. Prior to delivery, the engine generator set and all support components shall be factory tested and certified by the manufacturer. Engineer and Owner shall be given a 2-week notice prior to test date.

B. Prior to field tests, manufacturer's field service representative shall inspect the complete installation to assure that all components have been installed and connected in accordance with the manufacturer's requirements.

C. After completion of the installation, the generator set and support components shall be field tested by manufacturer's field service representative. The test shall include actual start-up and operation in both the automatic and manual modes. Engineer and Owner shall be given a 2-week notice prior to test date.

3.4 TRAINING

A. After the engine-generator set installation is complete and the manufacturer's field service representative has completed all field testing, the Owners personnel shall receive operation and maintenance instruction.

B. The instructions shall include demonstration and/or review of features, including but not limited to:
   1. All accessories.
   2. Lubrication procedures.
   3. Removal and installation of filters.
   4. Start up and shut down procedures.
   5. Power outage simulation.
   6. Transfer switch operation.
   7. Control panel features.
   8. Field adjustment of output voltage.
   9. Alarm and shutdown features.

END OF SECTION

SECTION 26 51 00 - LIGHTING

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. Luminaires.

B. Drivers.

C. Pole.

D. Installation.

1.2 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

B. Submit shop drawings in booklet form with separate sheet for each luminaire assembled in alphabetical order by 'type'. Submit manufacturer's data including dimensioned drawings and photometric data prepared by an independent nationally recognized testing lab.

C. Submit shop drawings for each ballast type and lamp as specified and/or indicated on the drawings.

D. Provide photometric data for each luminaire and a photometric analysis of each space where Contractor proposes using luminaires which is not listed in the Contract Documents or which does not have prior approval. Contractor shall assume full responsibility for scheduling and timing for the analysis. The following information shall be displayed in the analysis and Contractor shall modify the analysis and change data used upon request from Engineer/Owner at no additional cost or project schedule change.
   1. Illumination levels in foot-candles.
   2. Analysis/Calculation grid shall be suitable for the project area to give a realistic feel for the space and shall be readable.
   3. Height of analysis/calculation surface(s) in the model.
   4. Light Loss factor for each luminaire.
   5. Initial delivered lumens for each luminaire and lamp.
   6. Statistics for each space/area: Average, Maximum, Minimum, Max/Min Ratio, Avg/Min Ratio.
   7. Where the measured light levels of the installed luminaires does not meet or exceed the Contractor's photometric analysis, Contractor shall replace luminaires with the specified luminaires or other approved luminaire which meets the proposed light levels.

E. Samples:
   1. Contractor shall upon written request by the consultant, provide samples of any custom made components suitable for evaluation.
   2. Contractor shall upon written request by the consultant, provide samples of standard system components or software suitable for evaluation.
   3. Samples submitted in accordance with this section will be returned to the contractor following evaluation.

1.3 DESIGN CRIERIA

A. Where switching circuit designations are not identified in the Contract Documents, the area lighting system shall be controlled by the device(s) shown in the space.

B. Multiple lighting control zones in a shared space are identified in the Contract Documents with the use of switch designations.

C. The lighting control system shall be listed, approved and comply as required with all national, state and local energy codes to include but not limited to ASHRAE 90.1-2004.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Provide luminaires with lamps, for each outlet specified in the Contract Documents.

B. Reference luminaire schedule in the Contract Documents.

C. Provide U.L. approved luminaires.

D. The lumianire types required are as noted by a capital letter(s) and number(s) on the Drawings. Contractor is solely responsible for the exact quantities. Luminaire shapes shown on the Contract Documents do not necessarily equate to an exact length or quantity of luminaire; rather, the luminaire designation shown on the plans refer to the type of luminaire. It is the Contractors responsibility to provide the proper length and switching configuration in each space.

E. Provide disconnects at each lumianire as required by the NEC.

F. Unless indicated otherwise, provide color stabilized clear virgin acrylic diffusers for interior luminaires. Provide a minimum thickness of 0.156" for all troffer lenses.

2.2 DRIVERS

A. LED Drivers:
1. UL Class 2 power unit as per UL1310. It is also listed in the UL Sign Accessory Manual (UL SAM).
2. Class A sound rating.
3. Minimum operating ambient temperature of -40 degrees C.
4. Life expectancy of 100,000 hours or greater at an average ambient temperature of ≤ 40 degrees C with use of the luminaire it is supplied with.
5. Self-rise of 25 degrees C at maximum load in open air without heat sink.
6. Certified by UL for use in a dry or damp location (Outdoor Type I).
7. Tolerates sustained open circuit and short circuit output conditions without damage.
8. Allowable case temperature up to 85 degrees C.
9. Reduce output power to LEDs if maximum allowable case temperature is exceeded.
10. Driver complies with governing FCC rules and regulations.
11. Tolerate sustained open circuit and short circuit output conditions without damage and need of external fusing or trip devices.
12. Dimmable, controlled by 0-10V low voltage controller or other means compatible with lighting system controls.
13. Manufacturer shall have a 5 year history of producing LED lighting drivers for the North American market.

2.3 POLES

A. For Luminaire Type AA1 & AA2
1. As indicated on light fixture schedule.
2. Paint which matches the luminaire.
3. Base plate cover over bolts and base plate.
4. Handhole with gasketed cover.

B. All pole installations shall be capable of withstanding the forces produced by 90-mph winds with a 1.3-gust factor and the total number of luminaires and additional equipment required per pole.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Provide all hangers, rods, mounting brackets, supports, frames, etc. for proper and safe lumianire installation. Install all lumianires in accordance with manufacturers' recommendations and instructions. Refer to Section 26 05 29: "Supporting Devices" for approved supporting methods. Type of ceilings shall be verified so proper mounting hardware is furnished with each luminaire.

1. In the chemical handling rooms, areas designated to have non-metallic conduit and other areas designated on the Drawings, all hangers, fasteners, inserts, screws, etc. shall be PVC or nylon.

B. In general, luminaires shall be located where shown on the Contract Documents; however, Contractor shall check equipment locations and install luminaires so that piping, duct work, and other devices or equipment shall not interfere with the luminaire components or its performance.

C. Provide lumianires complete with all auxiliaries required for proper, safe and distortion free installation in the various ceiling constructions in which they appear. Coordinate ceiling types with the Architectural drawings and provide compatible luminaires.

D. Location of insulation above ceilings shall be verified where recessed luminaires are located. If insulation is present, Contractor shall provide IC rated luminaire or install barrier to separate luminaires from insulation per manufacturer's recommendations.

3.2 WIRING

A. Provide grounding type connectors for all conduit and cable.

B. Provide a neutral conductor with each switching circuit 120V (L-G) or greater.

C. Provide an insulated grounding conductor with each lighting circuit.

3.3 QUALITY CONTROL

A. At the time of substantial completion, all luminaires must be installed and lamped with new lamps. Install all luminaires complete with lenses, diffusers, reflectors, louvers and other required accessories. Furnish a minimum of one case of replacement lamps for each type and size lamp used. Deliver replacement stock to the Owner's storage space as directed by the Owner.

B. Lenses, refractors, and glassware shall be clean and free from cracks or chips. All reflectors, shades, luminaire bodies, etc. shall be free from dents and scratches. Replace any damaged reflectors, diffusers, louvers or other components at no expense to the Owner.

C. Clean all luminaires free of dust, finger prints, paint, etc.. All exposed tags and labels other than UL and emergency ballast identifiers shall be removed.

D. Perform aiming and adjustment of all lighting luminaires in accordance with instructions issued by the Engineer. Adjust all directional type luminaires (interior and exterior) after dark under the direction of the Engineer, and/or Owner.

E. Replace all defective drivers within the guarantee period at no cost to the Owner.

3.4 LIGHTING REBATE PROGRAM

A. Apply the Utility energy lighting rebate to this project. Secure on behalf of the Owner the maximum rebate. Include all negotiations and substantiation required.

3.5 IDENTIFICATION

A. Lighting control components shall be identified by laminated plastic nameplates with 1/4-inch white lettering on a black background. Identify each lighting contactor based on the loads served. In addition, identify the lighting control panels as such.

B. Each interior LED luminaire shall be provided with an adhesive label on the outside of the housing but concealed from normal view, such as above an ACT ceiling, or on the driver housing. Label shall identify the following items:
   1. Date of install
   2. Rated Lumen output
   3. Rated Color Temperature
   4. Rated input wattage

C. Each exterior LED luminaire shall be provided with an adhesive label on the outside of the housing but concealed from normal view, such as on the top side of a pole mounted fixture, ceiling, or on the driver housing.
   1. Pole Mounted Fixtures: Provide the label on the inside of the pole handhole cover.
   2. Exterior wallpacks, provide the label on the top side of the fixture.
   3. Label shall identify the following items:
      a. Date of install
      b. Rated Lumen output
      c. Rated Color Temperature
      d. Rated input wattage
      e. Distribution package type (example; Distribituion Type: IV)

D. Refer to Section 26 27 26 – Wiring Devices for requirements for switching devices.

END OF SECTION

SECTION 26 52 00 - EMERGENCY LIGHTING

PART 1 -- GENERAL

1.1 SECTION SUMMARY

A. Unit Battery Equipment.

B. Exit Signs.

C. Installation.

1.2 SHOP DRAWINGS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

1.3 QUALITY CONTROL

A. Where battery back-up units are indicated to be installed, battery back-up units must be installed in a manner that will allow the units to be accessible for maintenance and testing; remote testing capability shall be provided where units cannot be made readily accessible as defined by the NEC.

B. Egress and emergency lighting levels shall be verified during testing by Contractor. Systems shall meet minimum lighting levels required by the governing codes for a period of 90 minutes.

C. Prior to installation of exit signs and emergency egress lighting, Contractor shall contact the Building Official and Fire Marshal to arrange a walk-through to discuss exit sign and emergency lighting placement, approximately at the mid-point of construction. Contractor will be held responsible for cost to modify and/or add egress lighting and exit signs after wall and ceilings are covered.

PART 2 -- PRODUCTS

2.1 UNIT BATTERY EQUIPMENT

A. Provide unit battery equipment that adhere to the following minimum specifications:
   1. 120 and 240 volt operation.
   2. UL 924 listed.
   3. 6 or 12 volt, long life, maintenance-free, nickel cadmium type batteries.
   4. Batteries sized to illuminate all lamps for 90 minutes.
   5. Low voltage battery protection to prevent deep battery discharge during extended outages.
   6. Brown out sensing to activate unit when line voltage drops below 80%.
   7. Solid state load transfer relay.
   8. Integral internal solid state charger.
   9. Provide pilot light and test switch.
   10. Self-testing diagnostics
      a. Single multi-chromatic LED indicator to display two-state charging, test activation and three-state diagnostic status.
      b. Test switch provides manual activation of 30-second diagnostic testing for on-demand visual inspection. Self-diagnostic testing for five minutes every 30 days and 30 minutes bi-annually. Automatic test may be postponed for eight hours by activating manual test switch. Diagnostic evaluation of lamp, AC to DC transfer, charging and battery condition. Continuously monitors AC functionality.
      c. Load learning capability self-calibrates to DC load at first test, enabling it to detect a lamp failure on future tests. It may be recalibrated at any time by holding down the test switch for 15 seconds.
   11. Interior lamps/heads:
      a. Thermoplastic heads with fully adjustable swivel, rotation and tilt.
   12. Exterior lamps/heads
      a. UL wet label listed.
      b. Cast metal or milled housing and cast mounting brackets and boxes.

B. Performance:
   1. Provide emergency lighting to illuminate the egress corridors and other required areas along the or to the path of egress. Refer to the light fixture schedule in the Contract Documents for specified types.
   2. Provide a minimum of 1.0 footcandle along the path of egress at the floor at 7'-6" mounting height above finished floor, unless mounting height is noted otherwise.
   3. If proposed fixtures do not provide this requirement with the layout provided in the Contract Documents, Contractor shall notify Engineer and provide the required quantity of fixtures to satisfy the AHJ requirements.

C. Approved Manufacturers:
   1. Refer to the Light Fixture Schedule.

2.2 EXIT SIGNS

A. Provide exit signs that adhere to the following minimum specifications:
   1. 120 operation.
   2. Multiple LED lamp source.
   3. NFPA 101 and EPA/DEP Energy Star Compliant.
   4. Universal mounting: right side (canopy), left side (canopy), top (canopy) and back.
   5. Knockouts for chevrons, right and left.
   6. Snap-in wiring connections to allow replacement of components without removing housing.

B. Battery Backup:
   1. Nickel cadmium batteries sized to provide 2 hours backup.
   2. Integral solid state battery charger.
   3. Low battery voltage protection
   4. Provide pilot light and test switch.
   5. AC "ON" indicator
   6. UL 924 listed

C. Approved Manufacturers:
   1. Refer to the light fixture schedule.

PART 3 -- EXECUTION

3.1 EMERGENCY EGRESS LIGHTING

A. Install a complete and operational emergency lighting system in accordance with NEC article 700 and Chapter 5 of NFPA 101 Life Safety Code.

B. Install equipment as recommended by the Manufacturer. Notify the Engineer of any discrepancies.

C. Support battery units directly from building structural members. Mount units to walls wherever possible.

D. Route raceway down from ceiling to wall mounted devices. Minimize the use of exposed raceway routed through finished spaces.

E. Connect emergency lights to the unswitched lighting branch circuit in the area served by the unit equipment.

F. Install remote emergency lights where indicated. Provide wiring between the remote heads and the battery packs to maintain UL listing of system.

G. Adjust emergency fixture heads for maximum effectiveness or as directed by the Engineer or AHJ.

3.2 EXIT SIGNS

A. Provide exit signs at each exit and along the egress path.

B. Mount exit signs to walls wherever possible. Where exit signs are shown to be installed to a lay-in ceiling, provide additional support from the building structure. Refer to Section 26 05 29: Supporting Devices for supporting requirements.

C. Connect exit signs to an unswitched lighting circuit. Circuit can be shared with unit battery equipment.

3.3 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one (1) year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

B. Provide this additional manufacturers warranties:
   1. Unit Battery Equipment: Provide 3 year warranty for NiCd battery type units with 5 year pro-rated warranty on NiCd batteries.
   2. Emergency Battery Ballasts: Provide 5 year warranty.

END OF SECTION

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SECTION 26 90 01 - MEASURING AND CONTROL INSTRUMENTS

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. Electronic Magnetic Flow Meter

B. Submersible Level Transducer

C. Float Switches

D. Wetwell Radar Level Transmitter

E. Radar Flow Transmitter

F. Chemical Tank Radar Level Transmitter

G. Dissolved Oxygen Sensor

H. pH Sensor

I. ORP Sensor

J. ORP, pH, DO Sensor Controller.

K. Temperate Alarm Thermostat

L. Gas Detection Device

M. Door Contact

N. Testing, Commissioning.

1.2 RELATED SECTIONS

A. Section 26 05 00 - Basic Electrical Materials and Methods.

1.3 SUBMITTALS

A. Refer to Section 26 05 00- Basic Electrical Materials and Methods for submittal requirements.

PART 2 -- PRODUCTS

2.1 ELECTROMAGNETIC (MAGNETIC) FLOW METER

A. Meter Design Conditions
   1. Electromagnetic induction meter producing a DC pulsed signal directly proportional and liner to liquid flow rate.
   2. Refer to Process documentation for flow meter sizes and pipe materials.

B. Quality Assurance
   1. Manufacturer of meter shall have at least 5-years' experience in the manufacture of magnetic flow meters and have a minimum of 100 United States installations of the model specified herein.
   2. The magnetic meter and the signal converter are to be from the same manufacturer.

C. Meter Construction
   1. Meter Tube
      a. Series 300 stainless steel.
      b. Carbon steel ANSI Class 150 flanges.
      c. Laying length at least 1.3 times the diameter of the meter body.
      d. Outer prime coating conforming to Section 09900.
      e. Lining shall be polyurethane or neoprene capable of withstanding an operating temperature of 185 degrees F.

2. Electrodes
    a. Provide with capacitive-type electrodes that do not come into direct contact with fluid.
    b. Series 316 stainless steel.
    c. Self-cleaning bullet nose type.
    d. Field replaceable without removal of meter from line.
3. Meter Housing
    a. Splash-proof and suitable for installation in Class 1, Division 2 environment.
4. Grounding Rings
    a. Series 316 stainless steel.
    b. Provide grounding straps as applicable.
5. Velocity Range
    a. Lower Range: 0 to 3 feet per second.
    b. Upper Range: 0 to 30 feet per second.
    c. Field adjustable between ranges.

D. Transmitter:
1. Provide remote transmitter electronic package or installed on flow tube as indicated on the Contract documents.

E. Electronics Package
1. Provide remote transmitter electronic package or installed on flow tube as indicated on the Contract documents.
2. Power Requirements: 120 VAC, 60 Hz.
3. Power Consumption: Maximum 5 watts per inch of flow tube diameter.
4. Operator interface with a minimum of 2-line LCD display.
5. Output Signals:
    a. 4-20mA DC directly proportional, and linear to flow rate.
    b. 0-10V pulse to identify a set flow total.
6. Isolation: Input and output signals isolated from each other. Electronics isolated from environment.
7. Low Flow Cut-Off: Inhibit output signal when flow rate is 2 percent or less of maximum flow setting.
8. Ambient Temperature Range: -40 degrees to +150 degrees F.
9. Relative Humidity Range: 10 percent to 95 percent.
10. Radio Frequency Interference Protection: Equivalent to SAMA Class 1 (A2).
11. Electronics unit to be interchangeable with other sized meters by same manufacturer.
12. Impedance: Input impedance minimum of 10^{12} ohms or a minimum of 10^{9} ohms when the meter design utilities a bi-polar pulsed dc excitation of the field coils.
13. Output Damping: Adjustable increments.
14. Cable: Signal and power cables to reach from the flow tube to the magnetic driver.
15. Remote Enclosure: NEMA 4 for wall mounting with rate indicator and 8-digit totalizer.

F. Meter/Electronics Performance
1. Accuracy:
    a. Between 3 fps and 30 fps: + 0.5 percent of actual flow rate.
    b. From 0.3 fps to 3 fps: + 1.0 percent of actual flow rate.
2. Repeatability: + 0.10 percent of full scale.
3. Drift: Complete continuous zero stability. System zero is not affected by any process coating of the electrodes.
4. Zero Stability: Fully automatic with no manual adjustment required. System zero shall be able to be set without establishing a no flow, full pipe condition.

5. Calibration: Each meter independently calibrated prior to shipment. Submit results of calibration tests with the Operation and Maintenance Manuals.

G. Spare Parts
   1. Provide 2 blind flanges for each magnetic flowmeter. Blind flanges shall be sized to fit flange where flow sensor is mounted and provide a watertight seal.

H. Manufacturer
   1. Endress Houser
   2. Rosemount
   3. Or Equal.

2.2 SUBMERSIBLE LEVEL TRANSDUCER

A. Welded 316 stainless steel body.

B. 2.5-inch minimum diameter Teflon faced pressure-transmitting diaphragm.

C. Solid-state type internal transducer.

D. Stainless steel nose cage with a minimum of 4” diameter. Cage height 1-2”.

E. Accuracy (including effects of linearity, hysteresis, and repeatability) of ± 0.25 percent of full span.

F. Sealed cable entry.

G. Stainless steel connecting hardware, clamps, cables, etc. as required for mounting in wet well.

H. Pressure range as required.

I. Waterproof shielded cable.

J. Sufficient length of cable to reach from the bottom of the wet well to the control panel.

K. Manufacturer:
   1. KPSI 750
   2. MEAS LTB
   3. APG PT-500
   4. Or Equal.

2.3 FLOAT LEVEL SWITCH

A. Impact/corrosion resistant ABS float body.

B. Non-Mercury mechanical switch rated 13.0 amp. at 120/240 Vac.

C. Foam-filled body.

D. Heavy duty, Type SJOW #16/2 cord. Cable long enough to reach control panel without a splice.

E. Completely potted switch-to-cable-to-body connection.

F. Stainless steel cable and 15-lb. plastisol-coated cast iron weight for mounting float switches.

G. Stainless steel fasteners with rubber sleeves for attaching floats to the stainless-steel cable.

H. Manufacturer:
   1. Anchor Scientific Eco-Float
   2. Or Equal

2.4 WETWELL RADAR LEVEL TRANSMITTER

A. Hermetically sealed wiring and fully potted electronics

B. Capable of submergence without degradation.

C. Operating Temperature Range: - 40 to 170 degrees F.

D. Accuracy up to 0.1inch.

E. Rated for use in wet location.

F. Loop powered, 4-20mA input/output directly connected to PLC input. No external power source or digital display on unit.

G. Manufacturer mounting hardware suitable for location.
   1. Provide a pivoting stainless-steel bracket and all stainless-steel mounting hardware for this purpose, allowing the unit to be removed for service without the use of tools or special equipment. Confirm mounting bracket with Engineer. Coordinate bracket location to allow for an unimpeded signal reflection from the transducer.

H. FM listed for use in a Class 1, Division 1, Group D hazardous location.

I. Manufacturer:
   1. Vega Vegapuls C 11
   2. Or equal.

2.5 RADAR FLOW MEASURING TRANSMITTER

A. Direct flow-proportional output signal without the use of remote transmitter.

B. A 4-20 Ma output signal proportional to flow from 0 to 100 percent with a resolution of plus or minus 0.1 percent and an accuracy of 0.25 percent of range.

C. Programmable by entering all operational data via Bluetooth using free app on smartphone, tablet, or laptop.

D. Integral temperature compensation sensor.

E. Operating Temperature Range: - 40 degrees C to 80 degrees F.

F. Hermetically sealed in chemically resistant material.

G. Capable of submergence without degradation.

H. Manufacturer mounting hardware suitable for location.
   1. Provide a pivoting stainless-steel bracket and all stainless-steel mounting hardware for this purpose, allowing the unit to be removed for service without the use of tools or special equipment. Confirm mounting bracket with Engineer. Coordinate bracket location to allow for an unimpeded signal reflection from the transducer.

I. Rated by FM for a Class I, Division 1 hazardous location.

J. Manufacturer:
   1. Vega Vegapuls C 21
   2. Or equal.

2.6 CHEMICAL TANK RADAR LEVEL TRANSMITTER

A. Non-contact radar level measuring system for monitoring the level in chemical storage vessels. Unit to be mounted on outside of tank or above tank.

B. Designed to measure chemicals through the walls of the tank.

C. Operating temperature range - 40 to 80 degrees C, with internal temperature sensor to compensate for temperature changes.

D. A 4-20mA output signal proportional to level from 0 to 100 percent with a resolution of plus or minus 0.1 percent and an accuracy of 0.15 percent of range.

E. An operational range, which is adjustable by entering new data via keypad without the use of additional equipment.

F. Maximum measurement range of 20 feet, minimal range suited for the size of the chemical vessel of which the device is mounted on. Blanking distance of 10 inches or less.

G. Programmable with handheld programming device.

H. EEPROM memory, which does not require a battery to ensure protection of stored data.

I. Enclosure material PBT; transducer material suited for the chemical application, ETFE or PVDF.

J. 24VDC loop powered device.

K. Hardware mounting as necessary to mount instrument above the tank.

L. Manufacturer:
   1. Vega
   2. Or equal.

2.7 DISSOLVED OXYGEN (DO) SENSOR

A. The measurement principle shall be optical by means of the technology frequency domain lifetime-based luminescence quenching and signal processing.

B. Dissolved oxygen measurement system components shall be designed to be part of an analytical process control system with enhanced protection from overvoltage due to lightning and power supply fluctuations.

C. Sensor Unit:
   1. The sensor shall have an integrated NTC thermistor.
   2. The sensor shall use green LED light with fluorescing optics and an equal path reference system.
   3. The sensor shall not require calibration. Replacement sensor caps shall contain a built-in microchip, not requiring field calibration upon installation.
   4. The sensor shall include self-diagnostics for monitoring of membrane sensing element function.
   5. The sensor output signal shall be digital.
   6. The sensor shall detach from sensor cable allowing for easy replacement or repair.
   7. The sensor shall be designed to be non-incendive and nonarcing.
   8. Shaft: V4A Stainless Steel
   9. Sensor head: POM and PVC
   10. Plug: ETFE
   11. Fixing Ring: POM
   12. Certifications
      a. Safety: CE, cETLus
      b. Hazardous locations: CSA C22.2 No.213, ANSI/ISA 12.12.01
   13. Protection rating: IP68
   14. Warranty: 2 yrs.

D. Sensor connection cable
   1. Conductors: Tin-coated stranded copper wire
   2. Coupling ring: Stainless Steel
   3. Ring: POM
   4. Screw: Stainless Steel V4A
   5. O-ring: NBR
   6. Enclosure: POM
   7. Nut: Stainless Steel 1.4571 (equivalent to 316Ti)
   8. Protection ring: POM
   9. Cable sheath: PUR
   10. Protective cap: PVC
   11. Protection rating: IP68 (waterproof)

E. Swing mount mounting hardware secured to concrete structure and accessible from the walkway.

F. Hazardous location rating.

G. Manufacturer:
   1. Hach
   2. Pre-approved Equal.

2.8 PH TRANSDUCER

A. Encapsulated sensor with digital signal processor, pre-amplifier, reference electrode, measuring electrode, ground electrode, and replaceable salt bridge.

B. Integral cable.

C. Wetted material:
   1. PEEK®

D. Integral RTD temperature compensator with accuracy of 0.9 degree F or better.

E. 0.02 pH accuracy.

F. Drift of no more than 0.03 pH per 24 hours, non-cumulative.

G. 10ft. per second flow rating.

H. Range of -2.0 to 14.0 pH.

I. Insertion body style:
   1. 1-inch NPT threads only on the cable end to mount into a GLI ball valve hardware assembly so that the sensor can be inserted into or retracted from the process without stop to the process flow.
   2. Sanitary body style: 2-inch flange to mount into GLI 2-inch sanitary tee with special cap and EDPM compound gasket.

J. Hazardous location rating.

K. Manufacturer:
   1. Hach pHD
   2. Pre-approved Equal.

2.9 ORP TRANSDUCER

A. Three electrodes. Process and reference electrodes measure the ORP differentially with respect to a third ground electrode.

B. Integral cable.

C. Wetted material:
   1. PEEK®

D. Integral RTD temperature compensator with accuracy of 0.9 degree F or better.

E. 0.5 mV accuracy.

F. 10ft. per second flow rating.

G. Range of -1500 to +1500 mV ORP

H. Insertion body style:

1. 1-inch NPT threads only on the cable end to mount into a GLI ball valve hardware assembly so that the sensor can be inserted into or retracted from the process without stop to the process flow.
2. Sanitary body style: 2-inch flange to mount into GLI 2-inch sanitary tee with special cap and EDPM compound gasket.

I. Hazardous location rating.

J. Manufacturer:
1. Hach pHD
2. Pre-approved Equal.

2.10 DO, ORP AND PH SENSORS CONTROLLER

A. Plug and play operation with no special configuration or programming needed.

B. 4-20mA analog output for each transducer for monitoring over the facility SCADA system.

C. Capable of monitoring up to 4 sensors.

D. ¼" inch VGA graphical backlit TFT color Glas/Glas-Touch screen, high resistance 320 x 240 pixels

E. 120V input power.

F. Manufacturer:
1. Hach SC1000 Probe Module
2. Pre-approved Equal.

2.11 FLOOR FLOOD ALARMS

A. Flood alarm switches which sense water on the floor shall consist of a suspended float element which shall magnetically operate a switch when float is lifted.

B. 1-inch movement of float to activate.

C. Unit shall be wall mounted and shall be equipped for conduit connection.

D. Non-chemical rooms:
1. Polycarbonate protective shield.
2. Manufacturer:
a. GEMS LS-270
b. Or equal.

E. Chemical rooms:
1. CPVC wetted parts
2. Manufacturer:
a. GEMS 74780
b. Or equal.

2.12 TEMPERATURE ALARM THERMOSTATS

A. Non-Corrosive Locations
1. Line voltage, heavy duty with SPDT contacts rated 7.4 amps at 120 Vac.
2. Control range 0 to 70 degrees F.
3. Manufacturer:
a. Honeywell T631A1030
b. Or equal.

B. Chemical Room Locations
1. Line voltage rated.
2. Heavy duty with SPDT switch rated 16.0 amps at 120 VAC.

3. 35 degrees F to 100 degrees F temperature range.
4. NEMA 4X enclosure with clear front cover to view set point.
5. Tin plated, externally mounted sensing element.
6. Manufacturer:
    a. Honeywell T631F1068
    b. Or equal.

C. Corrosive Hazardous Locations
1. Line voltage rated, 120 VAC.
2. Heavy duty with SPDT hermetically sealed switch rated 16.0 amps at 120 VAC.
3. 35 degrees F to 100 degrees F temperature range.
4. Enclosure rated for Class I, Division 1 and Division 2, Groups C & D per NEC Article 500. NEMA 4X with clear front cover to view set point.
5. Tin plated, externally mounted sensing element.
6. UL/CSA listed for Class I, Division 1 & 2, Groups C & D.
7. Manufacturer:
    a. Honeywell
    b. Ruffneck
    c. Chromalox
    d. Or equal.

2.13 GAS DETECTION DEVICES

A. Relay outputs for Alarm, Fault and Warning.

B. Transmitter with LED readout and allows for local calibration of the device and sensors.

C. Compatible with remote gas detection sensors.

D. Sensors rated for Hazardous area of which they are mounted in.

E. Mount sensors at elevation and location per manufacturer recommendations.

F. Sensors shall operate continuously at ambient temperatures between -40 and 60-degrees C.

G. Provide a 4-20mA signal proportional to measured combustible gas measured in space. To be monitored by SCADA.

H. Combustible Gas Sensor:
1. Infrared technology
2. Signal alarm upon 10% of the LEL.

I. Manufacturer:
1. MSA

2.14 DOOR CONTACTS

A. Surface mounted, hermetically sealed magnetic contacts, which are UL listed.

B. Contacts shall be rhodium plated, SPDT rated 0.3 amp at 30 Vdc with screw terminals.

C. Contacts shall be designed to operate with a gap of up to 1 inch.

D. Manufacturer:
1. Sentrol 1085T Series
2. Or equal.

PART 3 -- EXECUTION

3.1 COMMISSIONING

A. Contractor shall change relay connections, position limit switches, and make all other adjustments required to obtain the proper operation of the equipment.

B. Contractor shall demonstrate to the Owner and the Engineer that all control systems operate as specified.

3.2 TESTING AND COMMISSIONING

A. Contractor shall check, test, calibrate, and put into operation all control systems specified herein and shall demonstrate their operation to the Engineer.

B. All changes shall be recorded and all control schematic and wiring diagrams shall be revised and re-issued with the changes.

3.3 IDENTIFICATION

A. All devices shall be identified with a laminated plastic nameplate which has white lettering of not less than 3/16 inch on a black background. Nameplates shall be attached with screws.

B. Do not provide labels for the intrusion alarm stations.

END OF SECTION

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SECTION 26 90 02 - WASTEWATER TREATMENT CONTROL DESCRIPTION

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. Quality assurance/control system supplier.

B. Control description.

C. Control panel.

D. Spare parts.

E. Installation.

1.2 RELATED SECTIONS

A. Section 26 05 00 – Common Work Results for Electrical

1.3 SUBMITTALS

A. In addition to the requirements of this section, submit shop drawings and descriptive data in accordance with Division 1 and Section 26 05 00.

B. Drawings submitted for approval of control system equipment shall include the following information as applicable to each piece of equipment:

1. Detailed top, front, and end views.
2. Outline dimensions, including weights.
3. Control panel elevation drawings showing all components, both outdoor door and interior.
4. Control panel and starter electrical line diagrams and schematics.
5. Component device and material lists.
6. Cutsheets for each accessory.
7. Nameplate entries and schedules.
8. Features and accessories furnished to meet Specification requirements.
9. Cable access and exit areas, termination spaces, terminals, and wire ways.
10. Operator interface screens shall be submitted and reviewed with the Owner prior to the completion of the PLC and operator interface programming.

C. Operating and Maintenance Manuals

1. Provide Operating and Maintenance Manuals in a pdf format, compiled into a single pdf utilizing an interactive table of contents (TOC) with bookmarks and/or links to identify each component in the pdf and to take the reader directly to that page from the TOC.
2. All information contained in shop drawings.
3. List of spares provided.
4. List of spares recommended for stock.
5. Description of the operation, proper maintenance, and repair of all components.
6. Local sources of service and supply.
7. As built drawings.
8. Manufacturer’s operation and maintenance manuals.
9. Provide complete electronic copies of PLC, operator interface, and SCADA PC programs on USB drive.

a. USB drive shall be labeled to identify the equipment of which programs it contains.

b. 1 copy of the programming shall be provided in PDF format

c. 1 copy shall be provided in the PLC program's original format.

d. Contractor shall demonstrate to the Owner and Engineer that these drives contain all required documentation by opening up the drives on the Owner's computer and displaying the information to the satisfaction of the Owner and Engineer.

D. Base Bid Control System Integrator shall be as follows:

1. Automatic Systems Company – Roseville MN
2. InControl – Fridley MN
3. Total Control Systems – Stanchfield MN

E. Scope of Work:

1. This project includes the rehabilitation and expansion of the existing wastewater treatment plant and Main Lift Station. The plant control system shall include three PLC-based control panels, with a dedicated controller assigned to each major process area: pretreatment (SCP-2), biological treatment (SCP-1), and effluent/disinfection treatment (SCP-3). A remote I/O panel (RIO-1) shall be provided in the Blower Building and controlled by the biological-treatment PLC (SCP-1). The three control panels, remote I/O panel, local operator interface terminals (OITs), and SCADA computer with SCADA HMI software, located in the Administration Building shall be interconnected to form the complete wastewater treatment plant SCADA system.
2. The remote located Main Lift Station shall be monitored by the plant SCADA system and shall communicate with the plant over the radio.

F. Certifications:

1. All panels provided under this Section shall meet the requirements of UL-508 & UL-508A. The supervisory control system supplier shall maintain in-house UL-508 and UL-508A shop procedures for both open and enclosed Industrial Control Panels.
2. Control panels with intrinsically safe circuit extensions shall meet the requirements of UL-698A and shall be labeled as such, thereby certifying that the panel satisfies the UL requirements for an enclosed industrial control panel relating to hazardous locations with intrinsically safe circuit extensions.
3. All panels shall be provided with a label to identify the Short Circuit Current Rating (SCCR) given to the control panel assembly. Where the available short circuit rating or interrupting capacity is not identified in the contract documents, Contractor is responsible for coordinating with the electrical utility and for calculating these values. Panels which do not have an SCCR label or are provided with an inadequate SCCR value shall be replaced or corrected by the manufacturer. Corrective measures and work shall be covered by the Contractor at no additional cost to Owner. Nor will an extension to the project schedule be given for the corrective measures to be made.
4. All panels shall be UL labeled or third party certified in accordance with the governing state electrical code requirements.
5. All panels shall be labeled when delivered to the Site. All field modifications shall be in conformance with UL. When the Owner accepts the panels, the Contractor certifies that the panels have retained their UL labeling or other third-party certification accepted by the AHJ.

G. Experience:

1. The control system integrator shall for a minimum of 10 years, have been in business under their present name designing and implementing municipal water and wastewater system controls of equal or greater size in the State the project site is located. Experience of companies purchased

may be included as relevant experience as long as the purchased company's experience relates directly to this type and size of project. Relevant projects must include:

a. Lift station controls

b. Wastewater treatment facility controls

c. Pump control and PLC programming.

d. SCADA telemetry systems.

e. SCADA HMI software.

H. Maintenance and Service

1. The control system integrator shall have programmers, designers, and field service personnel who are permanent, full-time employees. The field service personnel shall be available 24 hours each day to assist the Owner with onsite issues.

2. Service representative shall maintain an inventory of all control components and shall be equipped with all tools required to repair the control panel.

3. Service representative shall respond promptly to a request for service.

4. Control panel manufacturer shall be located within a 200-mile radius of the project site.

I. Liability & Insurance:

1. Unless stated otherwise, the control system supplier shall carry a minimum of $5,000,000 in both product liability and errors and omissions insurance.

1.5 MAIN LIFT STATION CONTROL DESCRIPTION

E. Main Lift Station will have a submersible level transducer and two backup floats.

F. A Hand-Off-Auto control mode selector switch is to be provided on the control panel door for each pump.

1. Hand: the associated pump shall run regardless of if the control system is operational. Alarms, except motor overload or any other alarm that would void the pump manufacturer's warranty, shall not shut the pump down.

2. Off: the associated pump shall not be called to run.

3. Auto: the control panel shall run the pumps dependent on the liquid level of the wet well.

4. The hand and auto position of the selector switch shall be monitored by the PLC and the switch position is to be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an adjustable amount of time.

G. A simulated Hand-Off-Auto selector switch shall be provided for each pump at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated pump to operate.

2. Off – The PLC will not require the associated pump to operate.

3. Auto – The PLC shall operate the associated pump as described here-in.

H. AUTO (PLC) control mode:

1. The control panel PLC shall operate pumps based on the liquid level in the wet well.

2. Each pump is sufficient for normal demand, and only one pump will operate for most of the time. In case of high demand both pumps shall be running.

3. Pump starting/stopping shall be as follows:

a. When the wet well level is below an operator adjustable Pump Start elevation, all pumps shall be off.

b. When the wet well level rises above the Lead Pump Start elevation for a preset time, the lead pump shall start.

c. If the wet well level rises to an operator adjustable Lag Pump Start setpoint elevation for an operator adjustable time, the lag pump shall be started. At this time, both pumps are to be operating.

d. When the wetwell falls below an operator adjustable All Pumps Off level setpoint, the lead and lag pump operation shall be discontinued. Discontinuation of the pumps' operation shall be staggered by an operator adjustable time delay.

4. Pump Alternation:

a. Pumps shall automatically alternate lead duty every cycle. Operator shall be able to select manual alternation via the SCADA interfaces.
   1) If a required motor fails to start, an alarm shall be generated and the next motor in the sequence shall take over the lead pump position.
   2) The local SCADA interface shall indicate each motor's position in the alternation sequence.

b. An adjustable 0 to 3-minute timer at the PLC shall delay the starting of the lag pump.

c. If a required motor fails to start, an alarm shall be generated and the next motor in the sequence shall take over the lead pump position.

d. Indicate each motor's position in the alternation sequence on the SCADA interfaces.

5. A restart delay relay shall prevent the pumps from starting for an adjustable time delay of 0 to 3 minutes after it has stopped. The Restart Delay countdown shall be displayed on the operator interface screen during the restart delay period.

a. The restart delay timer setpoints shall be operator adjustable via the operator interface.

I. Two float control mode (While in AUTO):

1. Backup control shall be provided by 2 floats. Control relays and timers for the backup control shall be independent of the transducer and PLC controller.

2. High Level Float: A high level alarm float shall initiate a "High" wet well alarm and start both pumps with an adjustable time delay of 0 to 15 minutes between each pump's starting.

3. Low Level Float: If the wetwell level drops below the Low Level Float the SCADA system shall shut down the pumps and the control system shall go into the Backup Control Mode.

4. When backup control mode is active, an alarm indicator light on the control panel door shall illuminate and alarm shall be indicated on the SCADA system screens. Operator may transfer control back to PLC control by utilizing a simulated pushbutton on the OIT screen or utilizing an alarm acknowledge pushbutton at the control panel door.

5. Pump Alternation:

a. Pump starting sequence during the backup control mode shall be fixed (1 to 2).

J. Level measurement:

a. A submersible level transducer is to be mounted in the wetwell.

b. The transducer shall create a 4-20mA signal proportional to the wetwell level and shall be monitored by the lift station PLC.

c. The wetwell level is to be displayed and trended on the SCADA system interfaces and used for control as described above.

d. Operator is to utilize the SCADA interface screens to enter a High and Low Wetwell Alarm level setpoints. Upon the measured wetwell level rising or falling to the associated level for an operator adjustable amount of time, the SCADA system shall signal the appropriate alarm.

K. Pump Run Monitoring:

1. A digital accumulated run time shall be provided for each pump and displayed and trended on the SCADA screens. PLC shall track run anytime the pump is running.

a. Provide a reset button on the SCADA system to allow the operator to reset a pump's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

b. Provide a run time on the SCADA screens to show time when both pumps are running simultaneously. This shall also be trended.

2. Run time hour meters on inner control panel door:

a. Run time meters shall be provided on the control panel inner door to indicate the totalized run time. Run time meters shall track operation anytime the pump is running, whether in backup, hand and/or PLC control.

b. A run time meter on the control panel inner door shall totalize the amount of time, two pumps are running at the same time. Run time meter shall track operation anytime the pump is running, whether in backup, hand and/or SCADA control

3. When a pump is running, regardless of control mode, an associated green pump running pilot light shall illuminate on the control panel door and be signaled over the SCADA system.

L. Pump fail monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system and pilot lights shall indicate a pump fail alarm.

2. If a pump is required to run, and a run signal is not received by SCADA after an adjustable time delay expires, the SCADA system and pilot lights shall indicate a pump fail alarm.

M. Pump protection signals:

1. Temperature sensors supplied with the pump shall initiate a pump fail alarm and stop the pump upon an over temperature condition. Pump shall be locked out until manually reset. Temperature monitoring units shall be furnished by the pump supplier for installation in the lift station control panel.

2. Seal chamber moisture sensors supplied with the pump shall initiate a pump fail alarm upon detection of moisture in the seal chamber. Moisture monitoring units shall be furnished by the pump supplier for installation in the lift station control panel. A moisture alarm bypass switch shall be provided inside the control panel's inner door to allow disconnecting the moisture alarm from any alarm horn, exterior alarm light, and telemetry, if provided. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the moisture sensor circuitry when the circuit breaker is in the off position.

3. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the pump protection signals circuitry when the circuit breaker is in the off position.

4. SCADA system shall signal an alarm upon activation of the pump protection signals. Upon activation a pilot light on the control panel inner door shall illuminate. Pilot light colors as follows:

a. Pump Temperature Alarm – RED

b. Pump Seal Alarm – Amber

N. Power monitoring:

1. Service phase monitor:
    a. A phase monitor shall be provided in the control panel to monitor each incoming service phase. If a phase would lose power, the monitor shall signal an alarm to the PLC and a utility power failure alarm shall be generated over the SCADA system.
2. Utility surge protection device (SPD):
    a. An SPD shall be connected to the utility incoming lines to protect the downstream from surges which may present on the incoming utility.
    b. The control system shall monitor a common alarm contact at the SPD. Upon activation of the contact, the alarm shall be displayed on the SCADA screens.
    c. The control system shall monitor a surge counter contact at the SPD. SCADA system shall display the number of surges the SPD has protected against.

O. Generator Receptacle:
1. A portable generator receptacle shall be provided on main lift station control panel enclosure.
2. Receptacle shall be reverse services, with box and angle adapter.
3. Receptacle shall match the City of Spring Valley, MN portable generator.
4. A manual transfer switch shall be created by using a mechanical interlock to allow the utility main breaker or breaker tied to generator receptacle to be closed at any time. Only one is allowed to be closed at any given time.

1.6 INFLUENT FLOW, PH, AND TEMPERATURE MONITORING:

A. An existing Parshall flume is downstream of the grit collector. A radar transmitter shall be mounted over the Parshall flume to measure influent flow.

B. The SCADA system shall monitor a 4-20mA signal from the instrument which indicates the active flow rate.

C. Active flow rate and accumulated total flow for the meter shall be displayed and trended on the SCADA system.
1. Provide a reset button on the SCADA system to allow the operator to reset the total flow. A confirm message must appear to verify the Operator wants to reset the flow total and the button was not hit in error.

D. The Operator shall enter a high and low flow rate setpoint for the transmitter. If the flow modulates to or past a setpoint for an operator adjustable amount of time, the SCADA system shall signal the associated alarm.

E. Flow rate shall be used for wastewater process control as described in this Section.

F. Influent pH and Temperature:
1. A combination pH and temperature analyzer shall be provided ahead of the Parshall flume.
2. The transmitter shall generate a 4-20mA signal proportional to each measured parameter and shall be monitored by the SCADA system.
3. Measured pH and temperature shall be displayed and trended on the SCADA screens.
4. Operators shall use the SCADA screens to enter high and low pH alarm setpoints and a high temperature alarm setpoint. If a measured value rises or falls past an associated setpoint for an operator adjustable amount of time, the SCADA system shall signal the associated alarm.
5. The SCADA system shall monitor the analyzer for a loss of signal, sensor fault, or out of range condition and shall signal an instrument fault alarm.

1.7 INFLUENT SAMPLER:

A. The influent sampler shall be provided and shall be monitored by the SCADA system.

B. The SCADA system shall be hardwired to the influtn sampler and shall output a 4-20mA signal proportional to the plant influent flow rate.

C. The PLC system shall monitor sampler auxiliary contacts or outputs for indication of sampling status. Upon activation of such signal, the SCADA system shall indicate that the sampler is sampling.

1. The SCADA system shall accumulate and display the number of samples taken and shall trend the sample count. Provide a reset button on the SCADA system to allow the operator to reset the sample count. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

D. The PLC system shall monitor sampler auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate an influent sampler fail alarm.

1.8 PRETREATMENT LIFT STATION CONTROL DESCRIPTION:

A. Contractor to examine the existing control logic and compare to controls described in this section. In case of discrepancy, coordinate with process engineer and confirm the correct control strategy for this equipment.

B. The Pretreatment Lift Station is divided into two (2) separate wet wells. Three (3) existing constant speed pumps serve each wet well. The pumps discharge to the pretreatment channel ahead of the mechanical fine screen.

C. Each wet well is measured by an existing radar level transmitter and two new level floats as backup. Each wet well shall be controlled independently by the PLC and associated level transmitter as described below. Level floats shall serve as backup control and work independently from PLC.

D. A Hand-Off-Auto control mode selector switch is to be provided on the pretreatment building control panel (SCP-2) for each pump.

1. Hand: the associated pump will be required to operate regardless of the state of the PLC but controlled over the existing local control station mounted inside the pretreatment room. Alarms, except motor overload or any other alarm that would void the equipment manufacturer's warranty, shall not shut the pump down.

2. Off: the associated pump shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide automated control of the pump as described in this section.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

E. A simulated Hand-Off-Auto selector switch shall be provided for each pump at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated pump to operate.

2. Off – The PLC will not require the associated pump to operate.

3. Auto – The PLC shall operate the associated pump as described in this section.

F. AUTO (PLC) control mode:

1. The PLC pump control shall operate the three (3) pumps serving each wet well based on the liquid level in that wet well as sensed by the existing radar level transmitter for that wet well.

a. Pumps shall automatically alternate lead duty every cycle within each wet well. Operator shall be able to select manual alternation via the SCADA interfaces.
   1) If a required motor fails to start, an alarm shall be generated and the next motor in the sequence shall take over the required position.
   2) A display shall indicate each motor's position in the alternation sequence.

b. Operator shall be able to designate any pump as out of service via the SCADA interfaces. A pump designated out of service shall be removed from the alternation sequence and shall not be called to run in AUTO. When a pump is out of service or in a fail condition, the standby pump shall be advanced into the alternation sequence so that two pumps remain available.

2. Pump starting and stopping shall be as follows:

a. Operator shall enter a STAGE 1 START elevation, a STAGE 1 STOP elevation, a STAGE 2 START elevation, and a STAGE 2 STOP elevation for each wet well via the SCADA interfaces. All elevations shall be operator adjustable.

b. When the wet well level is below the STAGE 1 START elevation, all pumps serving that wet well shall be off.

c. When the wet well level rises above the STAGE 1 START elevation for an operator adjustable time period, the lead pump shall start.

d. If the wet well level continues to rise above the STAGE 2 START elevation for an operator adjustable time period, the lag pump shall start. Both the lead and lag pump shall then be operating.

e. If the wet well level falls below the STAGE 2 STOP elevation for an operator adjustable time period, the lag pump shall stop.

f. If the wet well level falls below the STAGE 1 STOP elevation for an operator adjustable time period, the lead pump shall stop.

g. An adjustable 0 to 3-minute timer at the PLC shall delay the starting of the lag pump.

h. An adjustable 0 to 60-second timer at the PLC shall delay the stopping of the lag pump so that pumps do not stop simultaneously.

3. A restart delay relay shall prevent a pump from starting for an adjustable time delay of 0 to 3 minutes after it has stopped. The Restart Delay countdown shall be displayed on the operator interface screen during the restart delay period.

a. The restart delay timer setpoints shall be operator adjustable via the operator interface.

4. Maximum run timer: Operator shall enter a maximum continuous run time for each pump. If a pump runs continuously for longer than this period, the SCADA system shall signal an alarm and shall transfer duty to the next available pump in the alternation sequence for that wet well.

G. Level measurement:

1. An existing radar level transmitter is provided in each pretreatment lift station wet well and shall be reused.

a. Each transmitter shall create a 4-20mA signal proportional to the level in the associated wet well and shall be monitored by the SCADA PLC.

b. Each wet well level is to be displayed and trended on the SCADA system interfaces and used for control as described above.

c. Operator is to utilize the SCADA interface screens to enter High and Low Wet Well Alarm level setpoints for each wet well. Upon the measured wet well level rising or falling to the associated level for an operator adjustable amount of time, the SCADA system shall signal the appropriate alarm identifying the affected wet well.

H. Float backup control mode (While in AUTO):

1. Backup control shall be provided by two floats in each wet well. Control relays and timers for the backup control shall be independent of the transmitter and PLC controller.

2. High Level Float: A high level alarm float shall initiate a “High” wet well alarm for the associated wet well and start two pumps with an adjustable time delay of 0 to 15 minutes between each pump’s starting.

3. All Pumps Off: When the wet well level falls to this point, all operating pumps in that wet well shall stop with an adjustable 0-60 second time delay between each pump stopping.

4. When backup control mode is active an alarm shall be indicated on the SCADA system screens identifying the affected wet well. Operator may transfer control back to PLC control by utilizing a simulated pushbutton on the SCADA screen.

I. Pump Run Monitoring:

1. The control system shall monitor the motor controller’s auxiliary contacts or outputs for indication of run status and for run time accumulation.

2. A digital accumulated run time shall be provided for each pump and displayed and trended on the SCADA screens. PLC shall track run time anytime the pump is running.

a. Provide a reset button on the SCADA system to allow the operator to reset a pump’s run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

b. Provide a run time on the SCADA screens to show time when multiple pumps are running simultaneously. This shall also be trended.

3. When a pump is running, an associated green running light shall illuminate on the SCADA screen.

J. Pump Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a pump fail alarm.

2. If a pump is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a pump fail alarm.

3. An associated pump failure red light shall illuminate on the SCADA screen.

K. Pump protection signals:

1. Existing pump protection modules shall be reinstalled in pretreatment building control panel (SCP-2).

2. Temperature sensors supplied with the pump shall initiate a pump fail alarm and stop the pump upon an over temperature condition.

3. Seal chamber moisture sensors supplied with the pump shall initiate a pump fail alarm upon detection of moisture. The pump shall be allowed to continue to operate.

4. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the pump protection relay upon the circuit breaker being opened.

5. SCADA system shall signal an alarm upon activation of the pump protection signals.

a. Pump Temperature Alarm – Red

b. Pump Seal Alarm – Amber

1.9 PRETREATMENT CHANNEL LEVEL MONITORING:

A. A radar level transmitter shall be provided in the pretreatment channel ahead of the mechanical fine screen.

1. The transmitter shall create a 4-20mA signal proportional to the channel level and shall be monitored by the SCADA PLC.

2. The channel level is to be displayed and trended on the SCADA system interfaces and used for control of the mechanical fine screen and grit collector.

3. Operator is to utilize the SCADA interface screens to enter a High Channel Level alarm setpoint and a High-High Channel Level alarm setpoint. Upon the measured channel level rising to the associated setpoint for an operator adjustable amount of time, the SCADA system shall signal the appropriate alarm.

1.10 MECHANICAL FINE SCREEN CONTROL DESCRIPTION:

A. The mechanical fine screen shall be furnished with a manufacturer's local control panel (LCP). The LCP shall include the screen drive starter, overload and jam protection, and a Hand-Off-Auto control mode selector switch.

B. Settings and control of the package unit operations will be utilized at this control panel.

C. System integrator shall coordinate with the system supplier to coordinate alarms. Operator may choose to enable or to disable all alarms from the package system. Upon activation of an enabled alarm, the SCADA system shall signal the associated alarm.

D. All package system information, alarms and status points shall be visible on the SCADA screens.

E. Package system shall accept run/off control signal from SCADA to provide remote control:

1. A simulated Hand-Off-Auto selector switch shall be provided for screen at the SCADA interface screens. The switch shall offer the following functions:

a. Hand – The PLC shall require the screen to operate.

b. Off – The PLC will not require the screen to operate.

c. Auto – The PLC shall operate the screen as described below. Operator shall choose the way of operation.

2. Level initiated operation: When the pretreatment channel level rises above an operator adjustable SCREEN START level for an operator adjustable time period, the screen shall be required to operate. The screen shall continue to operate until the channel level falls below an operator adjustable SCREEN STOP level and an operator adjustable run-on timer of 0 to 30 minutes expires.

3. Pump initiated operation: When one or more pretreatment lift station pumps are called to run, the screen shall be required to operate. The screen shall continue to operate for an operator adjustable run-on time of 0 to 30 minutes after the last pump stops.

4. Timed operation: Operator shall enter an OFF time and an ON time via the SCADA interfaces. The screen shall cycle on for the ON time and off for the OFF time regardless of channel level or pump status. Timed operation shall serve as the default mode of operation upon a channel level instrument fault.

1.11 GRIT COLLECTOR CONTROL DESCRIPTION:

A. The grit collector is existing system with existing control panel. New combination starter shall be provided for grit motor control. Contractor to examine the existing control logic and compare to controls described in this section. In case of discrepancy, coordinate with process engineer and confirm the correct control strategy for this equipment.

B. The SCADA system shall monitor the following signals from the grit collector local control panel, at minimum, and all signals shall be hardwired.

1. Grit collector running

2. Grit collector fail / common alarm

3. Control mode selector switch in Auto

C. System shall accept run/off control signal from SCADA to provide remote control:

1. A simulated Hand-Off-Auto selector switch shall be provided for grit collector at the SCADA interface screens. The switch shall offer the following functions:

   a. Hand – The PLC shall require the system to operate.

   b. Off – The PLC will not require the system to operate.

   c. Auto – The PLC shall operate the system as described below. Operator shall choose the way of operation.

2. Level initiated operation: When the pretreatment channel level rises above an operator adjustable level for an operator adjustable time period, the system shall be required to operate. The system shall continue to operate until the channel level falls below an operator adjustable level and an operator adjustable run-on timer of 0 to 30 minutes expires.

3. Pump initiated operation: When one or more pretreatment lift station pumps are called to run, the system shall be required to operate. The system shall continue to operate for an operator adjustable run-on time of 0 to 30 minutes after the last pump stops.

4. Whenever fine screen is operating.

1.12 ANOXIC BASIN JET MIX PUMP CONTROL DESCRIPTION:

A. Four (4) jet mix pumps shall be provided. One low level float shall be provided in each anoxic basin for dry run protection of the jet mix pumps.

B. A Hand-Off-Auto control mode selector switch is to be provided on the SCADA control panel (SCP-1) door for each pump.

1. Hand: the associated pump will be required to operate regardless of the state of the PLC. Alarms, except motor overload or any other alarm that would void the equipment manufacturer's warranty, shall not shut the pump down. VFD shall operate at a speed preset at the VFD.

2. Off: the associated pump shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide automated control of the pump as described in this section.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

C. A simulated Hand-Off-Auto selector switch shall be provided for each pump at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated pump to operate. The VFD shall operate at a speed the operator sets using the SCADA interfaces.

2. Off – The PLC will not require the associated pump to operate.

3. Auto – The PLC shall operate the associated pump as described in this section.

D. AUTO (PLC) control mode:

1. The jet mix pumps shall be scheduled to operate. Operator shall use the SCADA screens to select the desired mode of scheduled operation for each anoxic basin independently:

   a. Cycle Timer

   b. Time of Day Schedule

2. Cycle Timer:

a. Operator shall enter a mixer ON time and a mixer OFF time via the SCADA interfaces. Each timer shall be adjustable from 0 to 24 hours.

b. The pumps selected to operate in the associated basin shall be required to operate for the ON time, shall stop for the OFF time, and shall repeat continuously.

3. Time of Day Schedule:

a. Operator shall be able to program a seven (7) day schedule with a minimum of six (6) start and stop events per day for each anoxic basin. The schedule shall be entered and edited at the SCADA interfaces.

b. The pumps selected to operate in the associated basin shall be required to operate during each scheduled period.

4. Pump selection:

a. Operator shall select, via the SCADA interfaces, which jet mix pumps in each basin are called to run during a scheduled mixing period.

5. Speed control:

a. The operating speed of each jet mix pump shall be a manually adjustable setpoint entered by the operator at the SCADA interfaces. Process Engineer will direct the programmer on the initial speed setpoints at the time of startup.

6. Low level float protection:

a. The jet mix pumps serving a basin shall not be called to operate when the low level float in that basin is deactivated by a falling level.

b. Upon the low level float being deactivated while pumps are operating, the operating pumps in that basin shall be stopped and the SCADA system shall signal a jet mix low level alarm identifying the affected basin.

E. A 4-20mA signal shall be generated by the PLC for use of VFD speed control. The signal shall be proportional to the desired speed.

F. PLC shall accept a 4-20mA signal from the VFD for use of speed feedback monitoring.

G. Pump Run Monitoring:

1. The control system shall monitor the motor controller's auxiliary contacts or outputs for indication of run status and for run time accumulation.

2. PLC shall monitor a 4-20mA signal generated by the VFD which is to be proportional to the actual speed of the motor. The speed shall be displayed and trended on the SCADA screens.

3. A digital accumulated run time shall be provided for each pump and displayed and trended on the SCADA screens. PLC shall track run time anytime the pump is running.

a. Provide a reset button on the SCADA system to allow the operator to reset a pump's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

b. Provide a run time on the SCADA screens to show time when multiple pumps are running simultaneously. This shall also be trended.

4. When a pump is running, an associated green running light shall illuminate on the SCADA screen.

H. Pump Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a pump fail alarm.

2. If a pump is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a pump fail alarm.

3. If a motor is required to run, after an adjustable time delay expires to allow the VFD to get up to speed, PLC shall verify the VFD speed feedback signal matches the desired speed setpoint. If the feedback signal is not within an operator adjustable threshold, the SCADA system shall signal a motor speed alarm.

4. An associated pump failure red light shall illuminate on the SCADA screen.

I. Pump protection signals:

1. Temperature sensors supplied with the pump shall initiate a pump fail alarm and stop the pump upon an over temperature condition.

2. Seal chamber moisture sensors supplied with the pump shall initiate a pump fail alarm upon detection of moisture. The pump shall be allowed to continue to operate.

3. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the pump protection relay upon the circuit breaker being opened.

4. SCADA system shall signal an alarm upon activation of the pump protection signals.

a. Pump Temperature Alarm – Red

b. Pump Seal Alarm – Amber

1.13 MIXED LIQUOR RECYCLE (MLR) PUMP CONTROL DESCRIPTION:

A. Two (2) mixed liquor recycle pumps shall be provided in the MLR wet well.

B. The MLR wet well level shall be measured by a radar level transmitter. One low level float shall be provided in the MLR wet well for dry run protection of the pumps.

C. A Hand-Off-Auto control mode selector switch is to be provided on the SCADA control panel (SCP-1) door for each pump.

1. Hand: the associated pump will be required to operate regardless of the state of the PLC. Alarms, except motor overload or any other alarm that would void the equipment manufacturer's warranty, shall not shut the pump down. VFD shall operate at a speed preset at the VFD.

2. Off: the associated pump shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide automated control of the pump as described in this section.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

D. A simulated Hand-Off-Auto selector switch shall be provided for each pump at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated pump to operate. The VFD shall operate at a speed the operator sets using the SCADA interfaces.

2. Off – The PLC will not require the associated pump to operate.

3. Auto – The PLC shall operate the associated pump as described in this section.

E. AUTO (PLC) control mode:

1. The PLC shall modulate the speed of the MLR pump to maintain a mixed liquor recycle flow rate setpoint as measured by FE-3 in the common MLR header. The flow rate setpoint shall be calculated as a percentage of the averaged plant influent flow rate as measured by FE-1 at the Parshall flume. All ratios, setpoints, averaging periods, limits, and time delays described below shall be operator adjustable via the SCADA interfaces.

2. Averaged influent flow:

    a. The MLR pumps shall not be paced from the instantaneous influent flow rate. The SCADA system shall calculate a rolling average of the influent flow rate measured by FE-1 and shall use this averaged value as the pacing input.

    b. Operator shall enter an averaging period via the SCADA interfaces, adjustable from 1 to 24 hours. The SCADA system shall calculate the rolling average of the influent flow rate measured by FE-1 over this period.

    c. Both the instantaneous influent flow rate and the calculated averaged influent flow rate shall be displayed and trended on the SCADA screens.

3. Flow pacing:

    a. Operator shall enter an MLR ratio, expressed as a percentage of the averaged influent flow rate, via the SCADA interfaces.

    b. The SCADA system shall calculate the MLR flow rate setpoint as the averaged influent flow rate measured by FE-1 multiplied by the MLR ratio.

    c. Operator shall enter a minimum MLR flow setpoint and a maximum MLR flow setpoint which shall limit the calculated flow rate setpoint.

    d. Process Engineer will direct the programmer on the initial MLR ratio, averaging period, and minimum and maximum flow setpoints at the time of startup.

4. Maximum recycle volume limit:

    a. Operator shall enter a maximum recycle volume setpoint and a limit period via the SCADA interfaces. The limit period shall be adjustable from 1 to 24h.

    b. The SCADA system shall totalize the mixed liquor recycle volume measured by FE-3 within the current limit period.

    c. When the totalized recycle volume within the current limit period reaches the maximum recycle volume setpoint, the operating pump shall be stopped and shall not be permitted to restart for the remainder of that limit period.

    d. While the volume limit is in effect, the SCADA system shall signal an MLR volume limit reached alarm and shall display a message indicating that the pumps are stopped on the volume limit and the time remaining in the current limit period.

    e. The SCADA screens shall display the totalized recycle volume for the current limit period, the maximum recycle volume setpoint, the volume remaining before the limit is reached, and the time remaining in the current limit period. The totalized volume for each limit period shall be trended.

5. Operating level limits:

    a. The radar level transmitter in the MLR wet well shall measure levels within which the MLR pumps are permitted to operate. Operator shall enter a LOW LEVEL INHIBIT setpoint, a LOW LEVEL RESTART setpoint, and a HIGH LEVEL ALARM setpoint via the SCADA interfaces. All setpoints shall be operator adjustable.

    b. Low level inhibit: When the measured wet well level falls below the LOW LEVEL INHIBIT setpoint for an operator adjustable time period, the operating pump shall be stopped.

    c. High level alarm: When the measured wet well level rises above the HIGH LEVEL ALARM setpoint for an operator adjustable time period, the SCADA system shall signal an MLR wet well high level alarm. The MLR pumps shall be permitted to continue to operate.

6. Lead pump selection:

a. Only one MLR pump shall be permitted to operate at a time. The second pump shall serve as a redundant.

b. Operator shall use the SCADA screens to manually select the lead pump. Operator shall also be able to select automatic alternation of lead duty on an operator adjustable run time interval.

c. If the lead pump fails to start or is in a fail condition, an alarm shall be generated and the backup pump shall be started and shall assume lead duty.

d. A display shall indicate which pump is designated as lead and which is designated as backup.

7. Low level float protection:

a. The MLR pumps shall not be called to operate when the low level float in the MLR wet well is deactivated by a falling level.

b. Upon the low level float being deactivated while a pump is operating, the operating pump shall be stopped and the SCADA system shall signal an MLR wet well low level alarm.

F. A 4-20mA signal shall be generated by the PLC for use of VFD speed control. The signal shall be proportional to the desired speed.

G. PLC shall accept a 4-20mA signal from the VFD for use of speed feedback monitoring.

H. MLR wet well level measurement:

1. A radar level transmitter is to be provided in the MLR wet well.

a. The transmitter shall create a 4-20mA signal proportional to the wet well level and shall be monitored by the SCADA PLC.

b. The wet well level is to be displayed and trended on the SCADA system interfaces and used for control as described above.

c. Operator is to utilize the SCADA interface screens to enter High and Low Wet Well Alarm level setpoints. Upon the measured wet well level rising or falling to the associated level for an operator adjustable amount of time, the SCADA system shall signal the appropriate alarm.

I. Mixed Liquor Recycle Flow (FE-3):

1. The SCADA system shall monitor a 4-20mA signal from the flow meter which indicates the active flow rate.

2. A 0-10V pulse signal is to be generated by flow meter transmitter and monitored by the SCADA system. The signal shall pulse when a programed total amount of flow passes through. This signal shall be used to display totalized flow.

3. Active flow rate and accumulated total flow for the meter shall be displayed and trended on the SCADA system.

a. Provide a reset button on the SCADA system to allow the operator to reset the total flow. A confirm message must appear to verify the Operator wants to reset the flow total and the button was not hit in error.

4. The Operator shall enter a high and low flow rate setpoint for the transmitter. If the flow modulates to or past a setpoint for an operator adjustable amount of time, the SCADA system shall signal the associated alarm only if MLR pump is operating.

5. The SCADA system shall calculate and display the MLR recycle ratio as the mixed liquor recycle flow rate divided by the influent flow rate. The calculated ratio shall be displayed and trended.

6. If an MLR pump is called to run and no flow is registered at FE-3 after an operator adjustable time delay, the SCADA system shall signal no flow alarm.

J. Pump Run Monitoring:

1. The control system shall monitor the motor controller's auxiliary contacts or outputs for indication of run status and for run time accumulation.
2. PLC shall monitor a 4-20mA signal generated by the VFD which is to be proportional to the actual speed of the motor. The speed shall be displayed and trended on the SCADA screens.
3. A digital accumulated run time shall be provided for each pump and displayed and trended on the SCADA screens. PLC shall track run time anytime the pump is running.
    a. Provide a reset button on the SCADA system to allow the operator to reset a pump's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.
4. When a pump is running, an associated green running light shall illuminate on the SCADA screen.

K. Pump Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a pump fail alarm.
2. If a pump is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a pump fail alarm.
3. If a motor is required to run, after an adjustable time delay expires to allow the VFD to get up to speed, PLC shall verify the VFD speed feedback signal matches the desired speed setpoint. If the feedback signal is not within an operator adjustable threshold, the SCADA system shall signal a motor speed alarm.
4. An associated pump failure red light shall illuminate on the SCADA screen.

L. Pump protection signals:

1. Temperature sensors supplied with the pump shall initiate a pump fail alarm and stop the pump upon an over temperature condition.
2. Seal chamber moisture sensors supplied with the pump shall initiate a pump fail alarm upon detection of moisture. The pump shall be allowed to continue to operate.
3. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the pump protection relay upon the circuit breaker being opened.
4. SCADA system shall signal an alarm upon activation of the pump protection signals.
    a. Pump Temperature Alarm – Red
    b. Pump Seal Alarm – Amber

1.14 AERATION AND ANOXIC BASIN MONITORING:

A. A pH, ORP and DO analyzers shall be provided in aeration and anoxic basins. A transmitter shall be provided for each sensor to translate the measured value into a 4-20mA signal to be monitored by the SCADA system.

1. pH, ORP and DO – Anoxic Basin No. 1 (west)
2. pH, ORP and DO – Anoxic Basin No. 2 (east)
3. DO – Aeration Basin No. 1A (west)
4. DO – Aeration Basin No. 1B (west)
5. DO – Aeration Basin No. 2A (east)
6. DO – Aeration Basin No. 2B (east)

B. Each measured value shall be displayed on the SCADA screens and shall be trended.

C. Operators shall use the SCADA screens to enter a high and low alarm setpoint for each value. If the measured value rises or falls to the associated setpoint for an operator adjustable amount of time, the SCADA system shall signal the appropriate alarm.

1.15 AERATION BLOWER CONTROL DESCRIPTION:

A. Six (6) aeration blowers, ME-A-1 through ME-A-6, exist in the Blower Building. Blowers discharge to a common air header which serves Aeration Basins No. 1A and No. 2A, Aeration Basins No. 1B and No. 2B, and the sludge tanks.

B. A Hand-Off-Auto control mode selector switch is to be provided on the SCADA control panel (SCP-1) for each blower.

1. Hand: the associated blower will be required to operate regardless of the state of the PLC. Alarms, except motor overload or any other alarm that would void the equipment manufacturer's warranty, shall not shut the blower down. VFD shall operate at a speed preset at the VFD.

2. Off: the associated blower shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide automated control of the blower as described in this section.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

C. A simulated Hand-Off-Auto selector switch shall be provided for each blower at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated blower to operate. The VFD shall operate at a speed the operator sets using the SCADA interfaces.

2. Off – The PLC will not require the associated blower to operate.

3. Auto – The PLC shall operate the associated blower as described in this section.

D. AUTO (PLC) control mode:

1. The blowers shall be called to operate either periodically or on a schedule. Blower speed shall be a manually adjustable setpoint. The measured dissolved oxygen levels shall not be used to control the blowers.

2. Operator shall use the SCADA screens to select the desired mode of operation:

a. Cycle Timer

b. Time of Day Schedule

c. Continuous

3. Cycle Timer:

a. Operator shall enter a blower ON time and a blower OFF time via the SCADA interfaces. Each timer shall be adjustable from 0 to 24 hours.

b. The operator selected number of blowers shall be required to operate for the ON time, shall stop for the OFF time, and shall repeat continuously.

4. Time of Day Schedule:

a. Operator shall be able to program a seven (7) day schedule with a minimum of six (6) start and stop events per day. The schedule shall be entered and edited at the SCADA interfaces.

b. The operator selected number of blowers shall be required to operate during each scheduled period.

5. Continuous:
    a. The operator selected number of blowers shall be required to operate continuously.
6. Number of blowers operating:
    a. Operator shall enter, via the SCADA interfaces, the number of blowers to be called to run during each operating period and the maximum number of blowers permitted to operate simultaneously.
    b. When more than one blower is called, an adjustable 0 to 5-minute timer shall delay the start of each successive blower.
7. Speed control:
    a. The operating speed of each blower shall be a manually adjustable setpoint entered by the operator at the SCADA interfaces. Process Engineer will direct the programmer on the initial speed setpoints at the time of startup.
8. Sludge tank aeration demand: When sludge tank aeration is called for as described in this Section, at least one blower shall be required to operate at the operator entered speed setpoint regardless of the aeration basin blower schedule.
9. Blower Alternation:
    a. Operator shall use the SCADA screens to select the desired mode of alternation for the blowers:
        1) Manual
        2) Schedule
        3) Run Time
    b. Manual: Operators shall use the SCADA system to manually select the lead and lag blower(s). Designation will not change until the operator changes it.
    c. Schedule: Operator shall enter a day of the week when the blower lead/lag designations shall alternate. When the day of the week is reached, the designations shall rotate to the next blower in the sequence.
    d. Run Time: SCADA system shall offer a blower max runtime setting. When a blower runs for a period which reaches the setting, lead duty shall be transferred to the next available blower in the sequence.
    e. If a required blower fails to start, an alarm shall be generated and the next blower in the sequence shall take over.

E. A temperature sensor in each blower enclosure shall initiate a high temperature alarm and stop the blower upon an over temperature condition.
    1. A user adjustable timer shall be provided to bypass the temperature signal for a period while the blower is starting. Alarm shall no be triggered after the blower operation is discontinued, as heat stays trapped in the enclosure after the operation.

F. A 4-20mA signal shall be generated by the PLC for use of VFD speed control. The signal shall be proportional to the desired speed.

G. PLC shall accept a 4-20mA signal from the VFD for use of speed feedback monitoring.

H. Blower Run Monitoring:
    1. The control system shall monitor the motor controller's auxiliary contacts or outputs for indication of run status and for run time accumulation.
    2. PLC shall monitor a 4-20mA signal generated by the VFD which is to be proportional to the actual speed of the motor. The speed shall be displayed and trended on the SCADA screens.

3. A digital accumulated run time shall be provided for each blower and displayed and trended on the SCADA screens. PLC shall track run time anytime the blower is running.

    a. Provide a reset button on the SCADA system to allow the operator to reset a blower's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

    b. Provide a run time on the SCADA screens to show time when multiple blowers are running simultaneously. This shall also be trended.

4. When a blower is running, an associated green running light shall illuminate on the SCADA screen.

I. Blower Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a blower fail alarm.

2. If a blower is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a blower fail alarm.

3. If a motor is required to run, after an adjustable time delay expires to allow the VFD to get up to speed, PLC shall verify the VFD speed feedback signal matches the desired speed setpoint. If the feedback signal is not within an operator adjustable threshold, the SCADA system shall signal a motor speed alarm.

4. An associated blower failure red light shall illuminate on the SCADA screen.

J. Blower Building Temperature Alarm:

1. PLC shall monitor a high temperature alarm thermostat in the Blower Building.

2. Upon activation of a high temperature alarm, the SCADA system shall indicate a high temperature alarm in the Blower Building.

1.16 REAERATION BASIN BLOWER CONTROL DESCRIPTION:

A. Reaeration blower will be provided to supply air to the reaeration basin downstream of the chlorine contact effluent channel.

B. A Hand-Off-Auto control mode selector switch is to be provided on disinfection building control panel (SCP-3) for blower.

1. Hand: the associated blower will be required to operate regardless of the state of the PLC. Alarms, except motor overload or any other alarm that would void the equipment manufacturer's warranty, shall not shut the blower down. VFD shall operate at a speed preset at the VFD.

2. Off: the associated blower shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide control of the blower as described in this section.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

C. A simulated On-Off selector switch shall be provided for each blower at the SCADA interface screens. The switch shall offer the following functions:

1. On – The PLC shall require the associated blower to operate. The VFD shall operate at a speed the operator sets using the SCADA interfaces.

2. Off – The PLC will not require the associated blower to operate.

D. A temperature sensor in the blower enclosure shall initiate a high temperature alarm and stop the blower upon an over temperature condition. A user adjustable timer shall be provided to bypass the temperature signal for a period while the blower is starting.

E. A 4-20mA signal shall be generated by the PLC for use of VFD speed control. The signal shall be proportional to the desired speed.

F. PLC shall accept a 4-20mA signal from the VFD for use of speed feedback monitoring.

G. Blower Run Monitoring:

1. The control system shall monitor the motor controller's auxiliary contacts or outputs for indication of run status and for run time accumulation.

2. PLC shall monitor a 4-20mA signal generated by the VFD which is to be proportional to the actual speed of the motor. The speed shall be displayed and trended on the SCADA screens.

3. A digital accumulated run time shall be provided for each blower and displayed and trended on the SCADA screens. PLC shall track run time anytime the blower is running.

a. Provide a reset button on the SCADA system to allow the operator to reset a blower's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

4. When a blower is running, an associated green running light shall illuminate on the SCADA screen.

H. Blower Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a blower fail alarm.

2. If a blower is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a blower fail alarm.

3. If a motor is required to run, after an adjustable time delay expires to allow the VFD to get up to speed, PLC shall verify the VFD speed feedback signal matches the desired speed setpoint. If the feedback signal is not within an operator adjustable threshold, the SCADA system shall signal a motor speed alarm.

4. An associated blower failure red light shall illuminate on the SCADA screen.

1.17 CLARIFIER CONTROL DESCRIPTION:

A. A local control station shall be provided at each clarifier. The station shall be furnished with an Off/Reset-On selector switch for local control of the associated collector drive.

1. Off/Reset: the associated drive shall discontinue operation. Placing the switch in this position shall reset the drive fail condition and the associated limit switch latch, allowing the drive to be restarted.

2. On: the associated drive shall be required to operate regardless of the state of the PLC. Alarms, except motor overload, the drive shutdown limit switch, or any other alarm that would void the equipment manufacturer's warranty, shall not shut the drive down.

3. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

4. An alarm shall be generated over the SCADA system if the switch is left in the Off/Reset position for an operator adjustable amount of time.

B. A Hand-Off-Auto control mode selector switch is to be on SCADA Control Panel (SCP-1) door for each clarifier drive.

1. Hand: the associated drive will be required to operate regardless of the state of the PLC, provided the local control station selector switch is in the On position.

2. Off: the associated drive shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide automated control of the drive as described in this section, provided the local control station selector switch is in the On position.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

C. A simulated Hand-Off-Auto selector switch shall be provided for each collector drive at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated drive to operate.

2. Off – The PLC will not require the associated drive to operate.

3. Auto – The PLC shall operate the associated collector drive as described in this section.

D. AUTO (PLC) control mode:

1. Operator shall use the SCADA screens to select the desired mode of operation for each drive independently:

a. Continuous: the drive shall be required to operate continuously whenever influent flow is above operator adjustable set point.

b. Cycle Timer: Operator shall enter an ON time and an OFF time, each adjustable from 0 to 24 hours. The drive shall cycle on and off accordingly.

E. Drive limit switch monitoring:

1. Each clarifier drive is furnished with two (2) limit switches. The PLC shall monitor both limit switches for each collector drive and shall display their status on the SCADA screens.

a. Alarm limit switch: Upon activation, the SCADA system shall signal a clarifier alarm identifying the affected clarifier. The drive shall be permitted to continue to operate.

b. Shutdown limit switch: Upon activation, the drive shall be stopped through a hardwired circuit independent of the PLC and the SCADA system shall signal a clarifier shutdown alarm identifying the affected clarifier.

2. The shutdown condition shall be latched. The drive shall not be permitted to restart in Hand or in AUTO until an operator has gone to the clarifier, determined the cause of the condition, and manually reset the drive by placing the local control station selector switch in the Off/Reset position and returning it to the On position. A reset from the SCADA system shall not be provided.

3. While drive is in a latched shutdown condition, the SCADA system shall display a message indicating that a local manual reset at the clarifier is required.

F. Drive Run Monitoring:

1. The control system shall monitor the motor controller's auxiliary contacts or outputs for indication of run status and for run time accumulation.

2. A digital accumulated run time shall be provided for each collector drive and displayed and trended on the SCADA screens. PLC shall track run time anytime the collector drive is running.

a. Provide a reset button on the SCADA system to allow the operator to reset a collector drive's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

3. When drive is running, an associated green running light shall illuminate on the SCADA screen.

G. Drive Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a collector drive fail alarm.

2. If a collector drive is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a collector drive fail alarm.

3. An associated collector drive failure red light shall illuminate on the SCADA screen.

1.18 RETURN ACTIVATED SLUDGE (RAS) PUMP CONTROL DESCRIPTION:

A. The RAS Lift Station is divided into separate wet wells. Two (2) return activated sludge pumps serve each wet well. One wet well is serving clarifier No. 1 and other wet well is serving clarifier No. 2.

B. The pumps discharge to a common RAS header metered by FE-4 and return sludge to Control Structure No. 1. A motorized valve, V-RAS-13, is provided in the RAS header and a motorized valve, V-WAS-2, is provided in the waste activated sludge branch.

C. Two (2) floats shall be provided in each RAS Lift Station wet well - a pump OFF float for control and a low level alarm (LLA) float for pump protection.

D. A Hand-Off-Auto control mode selector switch is to be provided on SCADA control panel (SCP-1) door for each pump.

1. Hand: the associated pump will be required to operate regardless of the state of the PLC. Alarms, except motor overload or any other alarm that would void the equipment manufacturer's warranty, shall not shut the pump down. VFD shall operate at a speed preset at the VFD.

2. Off: the associated pump shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide automated control of the pump as described in this section.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

E. A simulated Hand-Off-Auto selector switch shall be provided for each pump at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated pump to operate. The VFD shall operate at a speed the operator sets using the SCADA interfaces.

2. Off – The PLC will not require the associated pump to operate.

3. Auto – The PLC shall operate the associated pump as described in this section.

F. AUTO (PLC) control mode:

1. Operator shall use the SCADA screens to select the desired mode of RAS control:

a. Flow Paced

b. Constant Flow

c. Constant Speed

d. Timed

2. Flow Paced:

a. Operator shall enter a desired RAS ratio, expressed as a percentage of the measured influent flow rate, via the SCADA interfaces.

b. The SCADA system shall calculate a RAS flow setpoint as the influent flow rate multiplied by the RAS ratio and shall modulate the speed of the operating pump to maintain the calculated setpoint as measured by FE-4.

c. Operator shall enter a minimum RAS flow setpoint and a maximum RAS flow setpoint which shall limit the calculated setpoint.

3. Constant Flow:

a. Operator shall enter a desired RAS flow rate setpoint via the SCADA interfaces. The SCADA system shall modulate the speed of the operating pump to maintain the setpoint as measured by FE-4.

4. Constant Speed:

a. Operator shall enter a desired pump speed setpoint via the SCADA interfaces. The operating pump shall run at the entered speed.

5. Timed:

a. Provide a timer setpoint to allow the operator to adjust duration of run time, off time, and speed. For example, the operator shall be able to set the designated lead pump to run at an adjustable speed for 10 minutes out of every 30 minutes.

6. Lead pump selection:

a. Only one pump per wet well shall operate at a time. The second pump in that wet well shall serve as redundant.

b. Operator shall use the SCADA screens to manually select the lead pump for each wet well. Operator shall also be able to select automatic alternation of lead duty on an operator adjustable run time interval.

c. If the lead pump fails to start or is in a fail condition, an alarm shall be generated and the backup pump in that wet well shall be started.

d. A display shall indicate which pump in each wet well is designated as lead and which is designated as backup.

7. Float control and protection:

a. Pump OFF float: When the OFF float in a wet well is deactivated by a falling level, the operating pump in that wet well shall be stopped.

b. Low level alarm (LLA) float: When the LLA float in a wet well is deactivated by a falling level, the SCADA system shall signal a RAS Lift Station low level alarm identifying the affected wet well and stop operating pump.

c. Float fail monitoring: If the OFF float is deactivated and the LLA float is not deactivated in the expected sequence, or if the LLA float is deactivated and the OFF float remains activated, the SCADA system shall signal a float fault alarm identifying the affected wet well.

8. Valve interlock: The RAS pumps shall not be called to operate unless the motorized RAS valve V-RAS-13 or the motorized WAS valve V-WAS-2 is confirmed open. Upon a loss of open position confirmation on both valves while a pump is operating, the operating pumps shall be stopped and the SCADA system shall signal an alarm.

G. A 4-20mA signal shall be generated by the PLC for use of VFD speed control. The signal shall be proportional to the desired speed.

H. PLC shall accept a 4-20mA signal from the VFD for use of speed feedback monitoring.

I. RAS Flow (FE-4):

1. The SCADA system shall monitor a 4-20mA signal from the flow meter which indicates the active flow rate.

2. A 0-10V pulse signal is to be generated by flow meter transmitter and monitored by the SCADA system. The signal shall pulse when a programed total amount of flow passes through. This signal shall be used to display totalized flow.

3. Active flow rate and accumulated total flow for the meter shall be displayed and trended on the SCADA system.

    a. Provide a reset button on the SCADA system to allow the operator to reset the total flow. A confirm message must appear to verify the Operator wants to reset the flow total and the button was not hit in error.

4. The Operator shall enter a high and low flow rate setpoint for the transmitter. If the flow modulates to or past a setpoint for an operator adjustable amount of time, the SCADA system shall signal the associated alarm.

J. Pump Run Monitoring:

1. The control system shall monitor the motor controller's auxiliary contacts or outputs for indication of run status and for run time accumulation.

2. PLC shall monitor a 4-20mA signal generated by the VFD which is to be proportional to the actual speed of the motor. The speed shall be displayed and trended on the SCADA screens.

3. A digital accumulated run time shall be provided for each pump and displayed and trended on the SCADA screens. PLC shall track run time anytime the pump is running.

    a. Provide a reset button on the SCADA system to allow the operator to reset a pump's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

4. When a pump is running, an associated green running light shall illuminate on the SCADA screen.

K. Pump Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a pump fail alarm.

2. If a pump is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a pump fail alarm.

3. If a motor is required to run, after an adjustable time delay expires to allow the VFD to get up to speed, PLC shall verify the VFD speed feedback signal matches the desired speed setpoint. If the feedback signal is not within an operator adjustable threshold, the SCADA system shall signal a motor speed alarm.

4. An associated pump failure red light shall illuminate on the SCADA screen.

L. Pump protection signals:

1. Temperature sensors supplied with the pump shall initiate a pump fail alarm and stop the pump upon an over temperature condition.

2. Seal chamber moisture sensors supplied with the pump shall initiate a pump fail alarm upon detection of moisture. The pump shall be allowed to continue to operate.

3. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the pump protection relay upon the circuit breaker being opened.

4. SCADA system shall signal an alarm upon activation of the pump protection signals.

    a. Pump Temperature Alarm – Red

    b. Pump Seal Alarm – Amber

1.19 WASTE ACTIVATED SLUDGE (WAS) CONTROL DESCRIPTION:

A. Waste activated sludge is taken from the common RAS header through motorized valve V-WAS-2 and is metered by FE-5 before being routed to Sludge Tank No. 1 or Sludge Tank No. 2.

B. AUTO (PLC) control mode:

1. Operator shall use the SCADA screens to select the desired mode of wasting:
    a. Volume Based
    b. Time Based
    c. Manual Initiate
2. Volume Based:
    a. Operator shall enter a target waste volume per wasting event and a seven (7) day schedule identifying the day and time of day each wasting event is to begin.
    b. At the scheduled time, the PLC shall confirm that at least one RAS pump is operating, or shall start the designated lead RAS pump, and shall open V-WAS-2 and close V-RAS-13.
    c. The SCADA system shall totalize the wasted volume as measured by FE-5. When the totalized volume reaches the target waste volume, the PLC shall close V-WAS-2 and open V-RAS-13, and shall return the RAS pumps to their normal mode of operation.
3. Time Based:
    a. Operator shall enter a wasting duration and a seven (7) day schedule identifying the day and time of day each wasting event is to begin. The sequence shall be as described above except that the event shall be terminated when the entered duration expires.
4. Manual Initiate:
    a. Operator shall initiate a wasting event from the SCADA interface using a simulated START pushbutton. The event shall run until the entered volume or duration is satisfied or until the operator presses a simulated STOP pushbutton.
5. Operator shall enter a maximum wasting duration. If a wasting event has not terminated when the maximum duration expires, the PLC shall terminate the event, return the valves to their normal position, and the SCADA system shall signal a WAS sequence alarm.
6. Sludge tank interlock: A wasting event shall not be initiated, and an active wasting event shall be terminated when the sludge tank level exceeds the operator adjustable high level setpoint. Upon such a condition, the SCADA system shall signal an alarm identifying the affected sludge tank.
7. Operator shall select the receiving sludge tank at the SCADA interface. The SCADA system shall display a reminder to the operator to confirm the position of manual valves V-WAS-3 and V-WAS-4 (sludge tank selection manual valves) prior to initiating a wasting event.
8. If V-WAS-2 is commanded open and no flow is registered at FE-5 after an operator adjustable time delay, the SCADA system shall signal a no flow alarm and shall terminate the wasting event.

C. WAS Flow (FE-5):
1. The SCADA system shall monitor a 4-20mA signal from the flow meter which indicates the active flow rate.
2. A 0-10V pulse signal is to be generated by flow meter transmitter and monitored by the SCADA system. The signal shall pulse when a programed total amount of flow passes through. This signal shall be used to display totalized flow.
3. Active flow rate and accumulated total flow for the meter shall be displayed and trended on the SCADA system.
    a. Provide a reset button on the SCADA system to allow the operator to reset the total flow. A confirm message must appear to verify the Operator wants to reset the flow total and the button was not hit in error.
4. The SCADA system shall record and display the volume wasted for each wasting event, and the daily, weekly, monthly, and yearly wasted volume totals. Totals shall be trended and available for report generation.

5. The Operator shall enter a high and low flow rate setpoint for the transmitter. If the flow modulates to or past a setpoint for an operator adjustable amount of time, the SCADA system shall signal the associated alarm.

1.20 SCUM LIFT STATION CONTROL DESCRIPTION:

A. One Scum Pump shall be provided in the Scum Lift Station. Scum from both final clarifiers is routed to the Scum Lift Station. Three (3) floats shall be provided in the Scum Lift Station wet well.

B. A Hand-Off-Auto control mode selector switch is to be provided on SCADA Control Panel (SCP-1) for Scum pump.

1. Hand: the associated pump will be required to operate regardless of the state of the PLC. Alarms, except motor overload or any other alarm that would void the equipment manufacturer's warranty, shall not shut the pump down.

2. Off: the associated pump shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide automated control of the pump as described in this section.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

C. A simulated Hand-Off-Auto selector switch shall be provided for each pump at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated pump to operate.

2. Off – The PLC will not require the associated pump to operate.

3. Auto – The PLC shall operate the associated pump as described in this section.

D. AUTO (PLC) control mode:

1. When the scum wet well level rises to activate the ON float for an operator adjustable time period, the pump shall be required to operate.

2. The pump shall continue to operate until the OFF float is deactivated by the falling level and an operator adjustable run-on timer of 0 to 5 minutes expires.

3. Upon activation of the high level alarm float, the SCADA system shall signal a Scum Lift Station high level alarm and require pump to operate.

4. Timed operation: Operator shall be able to enable a timed operating mode in which the pump is called to run for an operator adjustable ON time at an operator adjustable interval, independent of float status, provided the OFF float is activated.

5. Float fail monitoring: If the ON float is activated and the OFF float is not activated, or if the high level alarm float is activated and the ON float is not activated, the SCADA system shall signal a float fault alarm.

E. Pump Run Monitoring:

1. The control system shall monitor the motor controller's auxiliary contacts or outputs for indication of run status and for run time accumulation.

2. A digital accumulated run time shall be provided for each pump and displayed and trended on the SCADA screens. PLC shall track run time anytime the pump is running.

a. Provide a reset button on the SCADA system to allow the operator to reset a pump's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

3. When a pump is running, an associated green running light shall illuminate on the SCADA screen.

F. Pump Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a pump fail alarm.

2. If a pump is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a pump fail alarm.

3. An associated pump failure red light shall illuminate on the SCADA screen.

G. Pump protection signals:

1. Temperature sensors supplied with the pump shall initiate a pump fail alarm and stop the pump upon an over temperature condition.

2. Seal chamber moisture sensors supplied with the pump shall initiate a pump fail alarm upon detection of moisture. The pump shall be allowed to continue to operate.

3. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the pump protection relay upon the circuit breaker being opened.

4. SCADA system shall signal an alarm upon activation of the pump protection signals.

a. Pump Temperature Alarm – Red

b. Pump Seal Alarm – Amber

1.21 PLANT EFFLUENT FLOW MONITORING, FE-2:

A. The SCADA system shall monitor a 4-20mA signal from the flow meter which indicates the active flow rate.

B. A 0-10V pulse signal is to be generated by flow meter transmitter and monitored by the SCADA system. The signal shall pulse when a programed total amount of flow passes through. This signal shall be used to display totalized flow.

C. Active flow rate and accumulated total flow for the meter shall be displayed and trended on the SCADA system.

1. Provide a reset button on the SCADA system to allow the operator to reset the total flow. A confirm message must appear to verify the Operator wants to reset the flow total and the button was not hit in error.

D. The Operator shall enter a high and low flow rate setpoint for the transmitter. If the flow modulates to or past a setpoint for an operator adjustable amount of time, the SCADA system shall signal the associated alarm.

E. The flow rate measured by FE-2 shall be used for the following control functions described in this Section:

1. Chemical feed dosage pacing for the chlorine and sulfur dioxide chemical systems.

2. Reaeration basin blower control.

3. Flow proportional effluent sampling.

1.22 EFFLUENT SAMPLER:

A. The existing effluent sampler shall be reused and shall be monitored by the SCADA system.

B. The SCADA system shall be hardwired to the effluent sampler and shall output a 4-20mA signal proportional to the plant effluent flow rate as measured by FE-2 for use by the sampler in flow proportional sampling.

C. The PLC system shall monitor sampler auxiliary contacts or outputs for indication of sampling status. Upon activation of such signal, the SCADA system shall indicate that the sampler is sampling.

1. The SCADA system shall accumulate and display the number of samples taken and shall trend the sample count. Provide a reset button on the SCADA system to allow the operator to reset the sample count. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

D. The PLC system shall monitor sampler auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate an effluent sampler fail alarm.

1.23 UTILITY WATER PUMP CONTROL DESCRIPTION:

A. Two utility water pumps shall be provided in the chlorine contact basin. The utility water system supplies non-potable water to the Disinfection Building for use by the chlorine and sulfur dioxide chemical systems.

B. A Hand-Off-Auto control mode selector switch is to be provided on the disinfection building control panel (SCP-3) door for each pump.

1. Hand: the associated pump will be required to operate regardless of the state of the PLC. Alarms, except motor overload or any other alarm that would void the equipment manufacturer's warranty, shall not shut the pump down. VFD shall operate at a speed preset at the VFD.

2. Off: the associated pump shall discontinue operation.

3. Auto: the Operator may utilize the SCADA system to provide automated control of the pump as described in this section.

4. The position of the selector switch shall be monitored by the PLC and the switch position shall be displayed on the SCADA system screens.

5. An alarm shall be generated over the SCADA system if the switch is left in the Hand or Off position for an operator adjustable amount of time.

C. A simulated Hand-Off-Auto selector switch shall be provided for each pump at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated pump to operate. Pump speed shall be adjustable set point.

2. Off – The PLC will not require the associated pump to operate.

3. Auto – The PLC shall operate the associated pump as described in this section.

D. AUTO (PLC) control mode:

1. The utility water pumps shall be required to operate whenever the chlorine or sulfur dioxide chemical feed system is required to operate, regardless of the measured header pressure. The pump operating speed will be manually adjustable set point on SCADA screen.

2. Lead pump selection:

a. Only one pump shall be permitted to operate at a time. The second pump shall serve as the backup pump.

b. Operator shall use the SCADA screens to manually select the lead pump. Operator shall also be able to select automatic alternation of lead duty on an operator adjustable run time interval.

c. If the lead pump fails to start or is in a fail condition, an alarm shall be generated and the backup pump shall be started and shall assume lead duty.

E. Pump Run Monitoring:

1. The control system shall monitor the motor controller's auxiliary contacts or outputs for indication of run status and for run time accumulation.

2. A digital accumulated run time shall be provided for each pump and displayed and trended on the SCADA screens. PLC shall track run time anytime the pump is running.

a. Provide a reset button on the SCADA system to allow the operator to reset a pump's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

3. When a pump is running, an associated green running light shall illuminate on the SCADA screen.

F. Pump Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system shall indicate a pump fail alarm.

2. If a pump is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system shall indicate a pump fail alarm.

3. An associated pump failure red light shall illuminate on the SCADA screen.

G. Pump protection signals:

1. Temperature sensors supplied with the pump shall initiate a pump fail alarm and stop the pump upon an over temperature condition.

2. Seal chamber moisture sensors supplied with the pump shall initiate a pump fail alarm upon detection of moisture. The pump shall be allowed to continue to operate.

3. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the pump protection relay upon the circuit breaker being opened.

4. SCADA system shall signal an alarm upon activation of the pump protection signals.

a. Pump Temperature Alarm – Red

b. Pump Seal Alarm – Amber

1.24 SLUDGE TANK CONTROL DESCRIPTION:

A. There are two existing sludge tanks.

1. A radar level transmitter shall be provided at each sludge tank. The transmitter shall create a 4-20mA signal proportional to the tank level and shall be monitored by the SCADA PLC.

2. Measured level shall be converted to volume in gallons and to percent full. Level, volume, and percent full shall be displayed and trended on the SCADA screens for each tank.

3. Operator is to utilize the SCADA interface screens to enter High and Low Level alarm setpoints for each tank. Upon the measured level rising or falling to the associated setpoint for an operator adjustable amount of time, the SCADA system shall signal the appropriate alarm.

B. Sludge tank aeration:

1. Air is supplied to each sludge tank from the common blower air header through manually operated valves. Aeration to each tank is enabled and disabled by the operator at the manual valves.

2. Operator shall use the SCADA screens to select the desired mode of sludge tank aeration for each tank independently:

a. Manual: Operator shall start and stop the sludge tank aeration demand from the SCADA interface using simulated START and STOP pushbuttons.

3. The speed of the blower serving the sludge tank aeration demand shall be a manually adjustable setpoint entered by the operator at the SCADA interfaces as described in the Aeration Blower Control Description.

4. The SCADA system shall display the active aeration mode, the elapsed time in the current period, and the time remaining in the current period for each tank.

5. An accumulated aeration run time shall be maintained for each sludge tank and displayed and trended on the SCADA screens. Provide a reset button on the SCADA system to allow the operator

to reset each total. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

C. Sludge tank decant:

1. Decanting is initiated by the operator at the manually operated decant valves. The SCADA system shall monitor and totalize the decant flow from each tank.

2. A magnetic flow meter, FE-6, shall monitor the Sludge Tank No. 1 decant flow and a magnetic flow meter, FE-7, shall monitor the Sludge Tank No. 2 decant flow.

a. The SCADA system shall monitor a 4-20mA signal from each flow meter which indicates the active flow rate.

b. A 0-10V pulse signal is to be generated by flow meter transmitter and monitored by the SCADA system. The signal shall pulse when a programed total amount of flow passes through. This signal shall be used to display totalized flow.

c. Active flow rate and accumulated total flow for each meter shall be displayed and trended on the SCADA system.
1) Provide a reset button on the SCADA system to allow the operator to reset the total flow for each meter. A confirm message must appear to verify the Operator wants to reset the flow total and the button was not hit in error.

d. The Operator shall enter a high flow rate setpoint for each transmitter. If the flow modulates past the setpoint for an operator adjustable amount of time, the SCADA system shall signal the associated alarm.

3. The SCADA system shall display the decant volume removed from each tank during the current decant event and the daily, weekly, monthly, and yearly decant volume totals.

4. Upon the tank level falling below the operator adjustable MINIMUM DECANT LEVEL setpoint while decant flow is registered, the SCADA system shall signal a low decant level alarm advising the operator to close the decant valves.

1.25 SLUDGE LOADOUT PUMPS CONTROL DESCRIPTION:

A. A Hand-Off-Auto control mode selector switch is to be provided on the SCADA control panel (SCP-1) door for each pump.

1. Hand: the associated pump shall run regardless of if the control system is operational. Alarms, except motor overload or any other alarm that would void the pump manufacturer's warranty, shall not shut the pump down. VFD shall operate at a speed preset at the VFD.

2. Off: the associated pump shall not be called to run.

3. Auto: the control panel will operate via SCADA PLC.

4. The hand and auto position of the selector switch shall be monitored by the PLC and switch status to be displayed via the SCADA system.

5. An alarm shall be generated if the switch is left in the Hand or Off position for an adjustable amount of time.

B. A simulated Hand-Off-Local selector switch shall be provided at the SCADA interface screens. The switch shall offer the following functions:

1. Hand – The PLC shall require the associated pump to operate. The VFD shall operate at a speed the operator sets using the SCADA interfaces.

2. Off – The PLC will not require the associated pump to operate.

3. Local – The PLC shall allow the pump to operate.

4. PLC shall provide a digital required signal to the VFD when it is required to operate and a 4-20mA signal proportional to the desired speed setpoint. The speed of sludge pump shall be set using the SCADA interfaces.

C. LOCAL control mode:

1. The sludge transfer pump will be controlled by a remote-control station at the loadout station. Two switches are to be provided, one on the local control panel, the other on a cord pendant. The switches shall be RUN - OFF and offer the following modes of control.

a. RUN – PLC will allow the sludge transfer pump to operate via manual operation at the sludge loadout station.

b. OFF – The SCADA system will not require the transfer pump to operate.

D. If the emergency stop button at the local control station is activated, the VFD shall cease operation.

E. When the SCADA switch is not in the off position, the pump enabled light at the local control station shall illuminate.

F. Operator to use the SCADA screens to select the tank the pump(s) will be feeding from.

G. Tank levels shall be displayed at the load out station local control station, as well as on SCADA screen.

H. Upon a low sludge holding tank level (adjustable alarm set point), the transfer pump shall be disabled.

I. Pump Run Monitoring:

1. The PLC system shall monitor the motor controller auxiliary contacts or outputs for indication of run status and for run time accumulation.

2. A digital accumulated run time shall be provided for each pump and displayed and trended on the SCADA screens. PLC shall track run anytime the pump is running.

3. Provide a reset button on the SCADA system to allow the operator to reset a pump's run time meter. A confirm message must appear to verify the Operator wants to reset the total and the button was not hit in error.

4. Provide a daily and totalized run time.

5. When a pump is running, an associated green pump running pilot light shall illuminate on the SCADA screen along with a green running pilot light at the control station.

J. Pump Fail Monitoring:

1. The PLC system shall monitor motor controller auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system and pilot lights shall indicate a pump fail alarm.

2. If a pump is required to run, and a run signal is not received by the PLC after an adjustable time delay expires, the SCADA system and pilot lights shall indicate a pump fail alarm.

3. PLC shall monitor a 4-20mA speed feedback signal from the VFD. If the speed feedback doesn't match the desired operating speed, the SCADA signal shall signal a pump failure alarm.

4. If the local emergency stop button is activated, the VFD shall cease operation and an associated alarm shall be activated over the SCADA system.

5. An associated pump failure red pilot light shall illuminate on the SCADA screen and at the load out station remote control station.

K. Pump protection signals:

1. The pump is of a rotary lobe type. The motor current shall be monitored by the VFD. A high current setpoint at the VFD shall be used to monitor a condition where the pump is unable to pump the sludge. If the pump current draw reaches this setpoint at the VFD, the VFD function shall cease a pump failure – high current alarm shall be indicated on the SCADA system.

L. Sludge transfer pump flow:

1. A magnetic flow meter will monitor the flow from the transfer pump to the tanks (FE-10).

2. The transmitter will generate a 4-20mA signal proportional to the measured flow rate of the sludge in the pipe. This signal is to be monitored by the SCADA control panel, displayed on the SCADA interfaces, and trended at the SCADA PC.

3. A 0-10V pulse signal is to be generated by the flow meter transmitter and monitored by the SCADA system. The signal shall pulse when a programed total amount of flow passes through. This signal shall be used to display totalized flow at the SCADA interfaces.

4. Operator may enter a high and low flow alarm level setpoint. If the flow rate of the material rises or falls below the associated alarm level after a user adjustable time after the feed pump is required to operate or after a user adjustable time after the feed pump discontinues operation, SCADA system shall signal an alarm.

5. If flow is detected when there shouldn't be flow, the SCADA system shall signal an alarm.

1.26 CHLORINE CHEMICAL CONTROL:

A. SCADA system shall contain logic to control chemical system. Provide screens at the operator interface and SCADA screen to allow the operator to select either "AUTO" or "OFF" operation.

B. Chlorine contact basin feed point:

1. The chemical feed system shall run when effluent flow is above an adjustable minimum flow rate is sensed for a minimum of operator entered time setpoint (initially set to 15 seconds).

2. SCADA system will send a 4-20mA signal proportional to effluent flow rate to the automatic gas feed system and operate required feed solenoids.

C. Chlorine Leak gas detector:

1. A chlorine gas detector is to be provided in the chlorine gas storage room. If chlorine gas is detected, the transmitter will create alarm to SCADA and to emergency shut-off panel to close the cylinders.

2. The chlorine gas detector will produce a 4-20mA signal proportional to the measured gas levels in the storage room. This level shall be displayed on the SCADA system.

3. Operator shall be able to enter a Chlorine Leak Pre-alarm level via the SCADA interfaces. This alarm shall indicate a chlorine gas level rising in the chlorine room.

4. Operator shall be able to enter emergency alarm level via the SCADA interfaces. This alarm shall indicate a high level of chlorine gas in the room.

D. Chlorine Valve Emergency Shut-off system:

1. Each cylinder is to be provided with a solenoid to shut the cylinder valve upon a chlorine leak. When a chlorine leak alarm is generated by the chlorine gas detection system, the valve system shall close all chlorine valves and signal an alarm to the SCADA system.

2. Emergency pushbuttons are to be provided with the chlorine cylinder shut off system. Upon activation of any pushbutton, the chlorine cylinders valves shall close, and an alarm shall be indicated on the SCADA system.

3. A fire suppression flow and tamper switch signal shall also activate the chlorine cylinder shut off system.

E. Exhaust Fan:

1. The chlorine room exhaust fan shall be turned on using dedicated switches.

2. When the door is opened in the room, the exhaust fan shall be required to operate. When required to operate, a timer shall be provided to set the minimum run time the equipment shall operate

when the required signal is initiated. This timer is only applicable for door contact, so that fan runs for a timed period after the door is closed.

3. A green pilot light at the outdoor station shall illuminate when exhaust fan is in operation.

4. A red pilot light at the outdoor station shall illuminate if chlorine is detected by the gas detector. This shall be via dry contact at the chlorine detector.

F. Chlorine Scales:

1. Each chlorine cylinder will be set on a scale. A 4-20mA signal for each scale shall be monitored by the SCADA system generated by the scale transmitter panel. This signal shall be proportional to the measured weight of the chemical in the cylinder. This chemical weight shall be displayed on the SCADA screens and used for the following:

a. Chemical usage reports.

b. Operator shall utilize the SCADA interfaces to enter a chemical storage low level alarm weight setpoint. This will signal an indication that the chemical tanks need to be refilled or replaced.

c. The SCADA system shall recognize an increase in weight as a tank replacement and shall automatically "tare" the level to keep accurate account of chemical usage.

d. Operator shall be able to manually tare the system also via the SCADA system.

1.27 SULFER DIOXIDE CHEMICAL CONTROL:

A. SCADA system shall contain logic to control chemical system. Provide screens at the operator interface and SCADA screen to allow the operator to select either "AUTO" or "OFF" operation.

B. Chlorine contact basin feed point:

1. The chemical feed system shall run when effluent flow is above an adjustable minimum flow rate is sensed for a minimum of operator entered time setpoint (initially set to 15 seconds).

2. SCADA system will send a 4-20mA signal proportional to effluent flow rate to the automatic gas feed system.

C. Gas Leak:

1. A gas detector is to be provided in the sulfur dioxide room. If gas is detected, the transmitter will create alarm to SCADA and to emergency shut-off panel to close the cylinders.

2. The gas detector will produce a 4-20mA signal proportional to the measured gas levels in the room. This level shall be displayed on the SCADA system.

3. Operator shall be able to enter a Leak Pre-alarm level via the SCADA interfaces. This alarm shall indicate a gas level rising in the room.

4. Operator shall be able to enter emergency alarm level via the SCADA interfaces. This alarm shall indicate a high level of gas in the room.

D. Chemical Scale:

1. Each cylinder will be set on a scale. A 4-20mA signal for each scale shall be monitored by the SCADA system generated by the scale transmitter panel. This signal shall be proportional to the measured weight of the chemical in the cylinder. This chemical weight shall be displayed on the SCADA screens and used for the following:

a. Chemical usage reports.

b. Operator shall utilize the SCADA interfaces to enter a chemical storage low level alarm weight setpoint. This will signal an indication that the chemical tanks need to be replaced.

c. The SCADA system shall recognize an increase in weight as a tank replacement and shall automatically "tare" the level to keep accurate account of chemical usage.

d. Operator shall be able to manually tare the system also via the SCADA system.

1.28 SUPPLEMENTAL CARBON CONTROL:

A. PLC shall contain logic to control the chemical feed system. Provide screens at the operator interface and computers to allow the operator to select either “AUTO” or “OFF” operation for each system.

B. The chemical feed pumps shall run when influent flow is above an adjustable minimum flow rate and is sensed for a minimum of operator entered time setpoint (initially set to 15 seconds). PLC shall send a digital output signal to the chemical pump to signal for it to run.

C. PLC shall create a 4-20mA flow pace signal proportional to influent flow rate.

D. PLC shall monitor a 4-20mA signal generated by the feed pump which is to be proportional to the actual speed of the pump or feed rate. This value shall be displayed on the SCADA system along with the desired speed/feed rate setpoint.

E. When a system is in “OFF” mode, de-energize associated PLC outputs, and force associated pacing signals to 4.0mA.

F. Allow the operator to set up a proportional controller by picking a “minimum” rate point and a “maximum” rate point at any two points on the associated flow input signal. Generate a 4-20mA output to the chemical system that is linear over the selected control range. Adjust the flow pacing by an operator adjustable multiplier (determine range at startup).

G. The PLC system shall monitor feed pump auxiliary contacts or outputs for indication of fail status. Upon activation of such signal, the SCADA system and lights shall indicate a pump fail alarm.

H. PLC shall verify the feed pump speed/rate feedback signal matches the desired speed/rate setpoint. If the feedback signal is not within an operator adjustable threshold, the SCADA system shall signal a feed pump alarm.

I. Manual operation of the metering pump will be performed by operator using the keypad provided on the chemical feed pump.

J. Chemical Scale:

1. Chemical tank will be set on a scale. A 4-20mA signal shall be monitored by the SCADA system generated by the scale transmitter panel. This signal shall be proportional to the measured weight of the chemical in the tank. This chemical weight shall be displayed on the SCADA screens and used for the following:

a. Chemical usage reports.

b. Operator shall utilize the SCADA interfaces to enter a chemical storage low level alarm weight setpoint. This will signal an indication that the chemical tank need to be replaced.

c. The SCADA system shall recognize an increase in weight as a tank replacement and shall automatically “tare” the level to keep accurate account of chemical usage.

d. Operator shall be able to manually tare the system also via the SCADA system.

1.29 ELECTRICALLY ACTUATED VALVES:

A. Manual local control of all valves will be via utilizing the operators provided on the individual valves. Inaccessible valves shall have remote mounted local control station.

B. Open-Close actuators:

1. Provide a simulated Open-Auto-Close selector switch on the SCADA screens for all electrically actuated valves. Function of each position shall be as follows:
a. Open – PLC shall require the valve to open.
b. Closed – PLC shall require the valve to close.
c. Auto – PLC shall control the valve per the control descriptions.

C. Each valve has limit switches to verify valve position. PLC will monitor the full-open and full-closed dry-contacts of the limit switches for each valve to confirm valve position.

D. Ready status, alarm status, required position and verified position of each valve shall be displayed on the SCADA screens.

E. When the SCADA system requires a valve to change position, an operator adjustable timer shall begin. If the valve position is not verified to be in the desired position after the timer expires, the SCADA system shall signal a valve alarm.

1.30 STANDBY GENERATOR:

A. SCADA system shall monitor the following generator status points:

1. Generator running
2. Generator Common Alarm
3. Generator Ready
4. Low Fuel
5. 50% Fuel
6. 75% Fuel

B. Monitor the “pre-transfer alarm” contact in the automatic transfer switch and stop all automated processes prior to the switch transferring to generator power and prior to switch back to utility.

C. PLC shall step the startup of the pumps upon restoration of power:

1. Upon a power failure or power alarm, PLC shall shut down motors.
2. Upon power restoration PLC shall sequence the start of required motors and processes.
    a. Refer to Section 26 32 13 for generator sizing steps of equipment to turn on-line. Coordinate required sequences with generator supplier.

D. Alarms and monitoring points shall be displayed on the local graphical interface and the SCADA master screens.

E. Programming via the SCADA system shall allow operator to remotely start and stop the generator system.

F. Programming via the SCADA system shall allow the operator to set times for automatic generator operation. Operator may use the SCADA system to set the times of day the generator shall run for testing and operation purposes.

G. SCADA system shall generate an alarm if the normal power fails, a generator common alarm is generated, the generator is not in a ready status, and low fuel condition is present.

1.31 AUTOMATIC TRANSFER SWITCH:

A. The PLC shall monitor the following status indicators at the automatic transfer switch.

1. ATS in Normal/Utility Position
2. ATS in Generator Position
3. ATS Normal Power Available
4. ATS Generator Power Available

B. PLC shall monitor the automatic transfer switch positions and status contacts for normal power available and generator power available. These points shall be displayed on the SCADA system.

C. SCADA system shall generate an alarm if the normal power is not available.

1.32 POWER MONITORING:

A. SPD:

1. SCADA system shall monitor a surge counter contact at the SPD. The counts shall be accumulated by the PLC and displayed on the SCADA screens.

2. SCADA system shall monitor a common alarm contact at the SPD. The counts shall be accumulated by the PLC and displayed on the SCADA screens.

B. Control Panel/RIO panel Power:

1. A control relay shall be provided ahead of UPS for control panel and every RIO panel. PLC shall monitor a NO contact from this relay to indicate 120V control power OK. If this relay changes state, SCADA system shall indicate an alarm.

2. A control relay shall be provided downstream of the 24VDC power supply. PLC shall monitor a NO contact from this relay to indicate 24VDC control power OK. If this relay changes state, SCADA system shall indicate an alarm.

C. Control Panels/RIO panel UPS:

1. A UPS shall be provided to provide back-up power to the control circuit.

2. A relay shall be provided ahead of the UPS to indicate control power failure.

3. A UPS bypass circuit shall be provided via relay logic to switch the control circuit to be powered by the normal (non-UPS) power circuit upon a UPS fault. PLC shall monitor a contact for this circuit for identification of bypass status.

4. PLC shall monitor an alarm relay downstream of the UPS.

5. SCADA system shall signal an alarm upon activation of the above signals.

1.33 TELEMETRY:

A. A fiber optic network shall be provided within the WWTF in a ring topology, interconnecting the three (3) control panels, the remote I/O panel, and the SCADA PC in the Administration Building. The ring shall be configured so that a single break in the fiber path does not interrupt communication between any two devices on the network.

B. The remote Main Lift Station control panel shall communicate with the WWTF SCADA system over a radio link. The radio link shall be dedicated to this system, shall not be shared with any other user or system, and shall be encrypted.

C. The existing DSL internet connection in the Administration Building shall be reused. This connection shall serve general office use and shall be protected by a firewall.

1. The SCADA system's use of this connection shall be limited to outbound alarm notification only. No inbound access to the SCADA system from the internet shall be permitted.

2. The SCADA network shall be separated from the office network by the firewall, and firewall rules shall permit only the traffic required for alarm notification.

3. Upon loss of the primary alarm notification path, alarms shall be reported by the backup cellular alarm dialer described below.

D. Backup Cellular Alarm Dialer:

1. An operator adjustable timer shall start whenever an alarm is active in the SCADA system. If the alarm is not acknowledged before the timer expires, the SCADA system shall activate the backup cellular alarm dialer.

2. The SCADA system shall also activate the backup cellular alarm dialer immediately upon loss of the primary alarm notification path, without waiting for the timer to expire.

3. Activation of the backup dialer shall be indicated on the SCADA system screens and logged.

1.34 FLOW METER GENERAL:

A. The SCADA system shall monitor a 4-20mA signal from each flow meter which indicates the active flow rate.

B. The SCADA system shall monitor a 0-10V pulse signal from each flow meter which indicates total flow count.

C. Active flow rate and accumulated total flow for each meter shall be displayed and trended on the SCADA system.

1. Provide a reset button on the SCADA system to allow the operator to reset the total flow rate. A confirm message must appear to verify the Operator wants to reset the flow total and the button was not hit in error.

D. Flow meter signals also to be used for control as mentioned in the control description.

1.35 PRETREATMENT AND BLOWER BUILDING MAKE UP AIR UNITS:

A. The control of the MAU systems will be provided by the HVAC equipment supplier, unless noted otherwise.

B. When the lights are turned on, a signal shall be sent to MAU to indicate the space is occupied.

C. MAU shall accept combustible gas high level alarm signal from GAS detection transmitter.

D. SCADA system shall monitor the make-up air unit for the following signals:

1. MAU alarm

2. Exhaust fan alarm/not running.

E. The SCADA system shall monitor a MAU system alarm generated by the MAU. Upon such alarm, the SCADA system shall generate an HVAC alarm signal.

1.36 GAS DETECTION:

A. The SCADA system shall monitor a 4-20mA signal from gas detection sensor/device. This signal shall be proportional to the sensed level of combustible gas. This detected gas level shall be displayed on the SCADA system.

1. The Operator shall enter a high warning level and high alarm level setpoint for measured value. If the gas level modulates to or past a setpoint for an adjustable amount of time, the SCADA system shall signal the appropriate alarm.

B. A high alarm dry contact shall be monitored at each gas detections sensor/device. Upon activation of this contact, the SCADA system shall signal a combustible gas level alarm and signal shall be sent to MAU.

C. Gas monitor transmitter programmable relays shall be used for controlling GO/NO-GO indication panel mounted outside the building as indicated on drawings. Interlocking shall be done within SCADA control panel.

1.37 FLOOR FLOOD ALARM:

A. PLC shall monitor floor flood switch were shown on the Contract Documents.

B. Upon activation of a floor flood float, the SCADA system shall indicate a floor flood alarm in the associated area.

1.38 LOW TEMPERATURE ALARM:

A. PLC shall monitor low temperature alarm were shown on the Contract Documents.

B. Upon activation of a low temp alarm, the SCADA system shall indicate a low temp alarm in the associated area of the plant.

1.39 HIGH TEMPERATURE ALARM:

A. PLC shall monitor high temperature alarm were shown on the Contract Documents.

B. Upon activation of a low temp alarm, the SCADA system shall indicate a high temp alarm in the associated area of the plant.

1.40 GENERAL MOTOR CONTROL:

A. PLC shall monitor a running signal from each VFD and motor starter. When activated the SCADA system shall indicate the motor is running.

B. PLC shall monitor a failure signal from each VFD and motor starter. When activated the SCADA system shall indicate a failure alarm and indicate the motor as failed on the screens.

C. A 4-20mA signal shall be generated by the PLC for use of VFD speed control. The signal shall be proportional to the desired speed.

D. The PLC shall monitor and display a 4-20mA speed feedback signal from each VFD. This feedback signal shall be used as proof VFD is operating at desired speed.

E. A restart delay relay shall prevent a motor from starting for an adjustable time delay of 0 to 3 minutes after it has stopped.

1. A "Restart Delay" indicator on the operator interface screen shall be activated during the restart delay period.

F. Restart After Power Transfer:

1. After the automatic transfer switch transfer source power, the SCADA system shall automatically restart equipment in a timed sequence. Refer to Generator Specifications for sequence of stepped loads.

1.41 GENERAL CONTROL REQUIREMENTS:

A. Alarm Handling:

1. All alarms shall be indicated on the SCADA system and activate the alarm notification software and/or the alarm dialer if designated to do so.

a. Operator may utilize the SCADA PC HMI software to enable or disable any alarm. In addition, the operator may choose to have any alarm enabled or disabled for the alarm dialing software. If an alarm is enabled in the SCADA system, operator may choose to disable it from being signaled out via the alarm dialing software and alarm dialer.

2. When a SCADA alarm is signaled, the SCADA system shall first signal the alarm notification software to activate. If the alarm goes unanswered for an Operator entered amount of time, the SCADA system shall send the alarm to the alarm dialer.

3. Alarm lights and indication on the SCADA screens shall flash until the alarm is acknowledged. The lights/indication shall remain on until the alarm condition is cleared.

4. All alarms shall be logged by the SCADA computer system.

5. SCADA system shall log the time and who acknowledges an alarm, enables an alarm or disables an alarm.

B. The control system shall be fully operational in manual modes with the PLC and/or the SCADA PC system off-line.

C. The SCADA control system shall be fully operational with the SCADA PC offline.

D. Run times, analytical instruments, levels, pressures, flows, equipment run/fail indication, etc. shall be monitored/accumulated/displayed.

1. Daily, weekly, monthly, yearly, and total levels, run times, flows, pressures, etc. shall be displayed and recorded. The operator shall be able to use the SCADA system to view these values at any time desired.

E. All variables, such as starting sequence, on/off/alarm set points, time delays, etc., shall be operator adjustable via the SCADA screens.

F. Timers described throughout this Specification Section shall be timers made available to operator for adjustments via the SCADA system interfaces, unless noted otherwise.

PART 2 -- PRODUCTS

2.1 LIFT STATION OUTDOOR CONTROL PANEL

E. Free standing mounted on a concrete pad, low profile, rainproof, Type 3R.

F. UL-508, UL-698A rating.

G. 316 Stainless steel door-in-door construction. Interior white.

H. Panel(s) mounted on 18-inch-tall floor stands. Louvered skirt to cover space between floor stands. Material and finish to match the panel. Provide a screen on the interior side of skirt to prevent rodents, birds, bugs and other wildlife from entering the louvers. An air-tight sealed barrier shall be provided in the skirted area to separate conduits from the wetwell and non-wetwell.

I. The maximum overall height of panel with floor stands is 60 inches. Enclosure width shall be as required.

J. Exterior gasketed doors with continuous hinge and 3-point handle-operated latching system. Handle with provisions for padlocking; tumbler type lock is not acceptable.

K. Internal doors painted white with continuous hinge and quarter-turn latches.

L. Removable back panel painted white and mounted on threaded studs secured to the back of the enclosure. All devices mounted in the panel shall be mounted to this back panel. DIN rail shall be use for mounting all devices. Devices shall be removable without the need to remove screws and bolts.

M. Control devices and indicate lights mounted on interior doors.

N. Circuit breaker operating handles are accessible with interior doors closed.

O. All control relays, timers, pushbuttons, selector switches, PLC's, power supplies and other devices shall be provided in the control panel to meet the intent of the Contract Documents.

P. Internal heaters with adjustable thermostat control to prevent condensation and freezing. Heaters shall be sized as required to maintain temperature required for proper operation of all components inside the panel.

Q. Panel Ventilation/Cooling: ventilation and/or cooling shall be per manufacturer to maintain proper operating temperature for the components in the control panel.

1. Ventilation – As recommended by Control Panel Supplier
    a. Thermostatically controlled vent fan and fixed intake/discharge louvers.
    b. Air filters, filter retainer, filter sealing gasket and finger guard.
    c. Stainless steel shroud kits with finish to match panel.
2. Air Conditioning – As recommended by Control Panel Supplier
    a. Closed loop air conditioner with removable filter and integral thermostat.
    b. UL Listed for outdoor use.
    c. Mount on the side of control panel.
    d. Size: Air conditioner shall maintain an ambient temperature inside of the enclosure of at least 10 degrees F less than the maximum operating temperature of all devices in the control panel.
3. Design shall be for the following environmental extremes:

a. Summer: Direct sunlight exposure on the cabinet with an outdoor air temperature of 105 degrees F and all components, drives and devices operating at 100% capacity.

b. Winter: Outside ambient temperature as low as -60-degree F in darkness.

R. Control panel shall be provided with a control circuit surge arrestor, power supplies, and UPS.

S. Control panel shall include a means for SCADA to monitor a power failure condition on the line side of the UPS.

T. All input and output circuits which are tied to field terminals shall be individually fused. Additionally, each analog circuit shall include individual transient voltage surge protections as specified in the section.

U. All interface with instrumentation located outside of the panel shall be via interface relays. Terminations directly to PLC output or input module terminals is not acceptable.

V. New control panels:

1. 1/2" Foam insulation on interior of panel. Foam shall be secured to the panel in such a manner as the glue or tape doesn't degrade for a minimum of 20years.

2. A 12" tall x 12" wide x 1" deep pocket secured to the inside of the exterior door shall be provided for clipboard, control panel schematic drawings and other document storage.

3. Interior light for each compartment which turns on when the compartment door is opened.

4. A compartment barrier shall be provided to separate the high voltage components from the control components.

5. Sized to house all control components, with spare space on back panel to add 10% of each relay, fuse, PLC I/O card, breaker, and terminal blocks provided under this project.

6. The dimensions of panel should be as such to allow for the UPS to sit on the bottom or base of the control side compartment. Mounting the UPS to the side, the back, the top or any other space other than setting on the bottom of the panel will not be accepted.

2.2 SLUDGE LOADOUT CONTROL STATION ENCLOSURE

A. Unistrut mounted.

B. NEMA 4X enclosure, with inner door.

C. Panels shall be flanged, corners welded and ground smooth. All inside and exterior surfaces were treated to prevent oxidation and painted gray.

D. UL listed.

E. SCCR rating which exceeds the available short circuit current in the circuit at the point of the panel connection.

F. Enclosure shall be provided with a removable back panel, painted white, and secured to back of enclosure on studs with the use of screws.

G. All control relays, timers, pushbuttons, selector switches, and other devices shall be provided to meet the intent of the Contract Documents. Devices not mounted to door, shall be din rail mounted on the removable back panel.

H. Operator interface, pilot devices and indicating lights mounted on door.

I. All components labeled per shop drawings.

J. Panel Ventilation/Cooling: ventilation and/or cooling shall be as required to maintain proper operating temperature for the equipment in the control panel.

1. Thermostatically controlled fan-forced heaters for condensation/corrosion protection.

2. Thermostatically controlled exhaust fan to control temperature by exhausting heat inside the enclosure.

K. Transient and surge suppression shall be provided for power and control input and output.

L. A 12-inch x 12-inch x 1-inch pocket inside the exterior door shall be provided for clipboard and information storage.

M. Provide a laminated phenolic nameplate attached with screws on the outer door, which identifies the control panel.

2.3 CONTROL PANEL ENCLOSURE

A. Wall or floor mounted in proposed locations shown on the drawings.

1. Floor mounted enclosures to be mounted on a 2" minimum concrete housekeeping pad or on floor stands.

B. Panels shall be flanged, corners welded and ground smooth. All inside and exterior surfaces were treated to prevent oxidation and painted gray.

C. UL listed.

D. SCCR rating which exceeds the available short circuit current in the circuit at the point of the panel connection.

E. Indoor enclosures shall have NEMA 12 rating with continuous hinge and 3-point latching with a key-lockable handle, unless noted otherwise. Key-lockable handle.

F. Enclosure shall be provided with a removable back panel, painted white, and secured to back of enclosure on studs with the use of screws.

G. All control relays, timers, pushbuttons, selector switches, and other devices shall be provided to meet the intent of the Contract Documents. Devices not mounted to door, shall be din rail mounted on the removable back panel.

H. Operator interface, pilot devices and indicating lights mounted on door.

I. All components labeled per shop drawings.

J. All input and output circuits which tie to field terminals shall be individually fused. Additionally, each analog circuit shall include individual transient voltage surge protections as specified in the section.

K. All interface with motor controllers and other instrumentation located outside of the panel shall be via interface relays. Direct output from or input to PLC I/O terminals is not acceptable.

L. Control panels shall be provided with a control circuit surge arrestor, power supplies, and UPS.

M. Each control panel shall include a means for the PLC to monitor a power failure condition on the line side of the UPS.

N. Interior LED light, mounted at top of the enclosure, activated by door switch provided for each door of the enclosure.

1. Provide dedicated circuit breaker for lighting circuit powered ahead of the UPS.

O. Panel Ventilation/Cooling: ventilation and/or cooling shall be as required to maintain proper operating temperature for the equipment in the control panel.

1. Thermostatically controlled fan-forced heaters for condensation/corrosion protection.

2. Thermostatically controlled exhaust fan to control temperature by exhausting heat inside the enclosure.

P. Transient and surge suppression shall be provided for power and control input and output.

Q. A 12-inch x 12-inch x 1-inch pocket inside the exterior door shall be provided for clipboard and information storage.

R. Sized to house all control components, with spare space on back panel to add 10% of each relay, fuse, PLC card, breaker and terminal blocks provided under this project.

S. The dimensions of panel shall be as such to allow for the UPS to sit on the bottom of the enclosure. Mounting the UPS to the side, the back, the top or any other space other than setting on the bottom of the panel will not be accepted.

T. Provide a laminated phenolic nameplate attached with screws on the outer door, which identifies the control panel.

U. Provide adequate space for network equipment mounting.

V. Additional open space shall be provided at each control panel to allow for a minimum of 6 future I/O modules. Space shall be provided for installation of associated I/O modules compatible with the PLC provided.

W. Intrinsically safe barriers shall be provided for each circuit entering classified area as indicated in design drawings.

2.4 PROGRAMMABLE LOGIC CONTROLLER

A. Programmable Controllers shall be manufactured to NEMA ICS 3 standards, with component circuit boards manufactured to NEMA ICS 2 standards.

B. Provide backup memory module and battery backed RAM, with 25% spare capacity for future programing and control functions.

C. Power supply capable of supplying necessary power to all subsystems and a minimum of 7 expansion I/O modules.

D. PLC shall be 24VDC powered.

E. Diagnostic indicators for CPU status and status indicator for each I/O point.

F. Provide fusing for all inputs and outputs.

G. Cables and all accessories as required for complete system operation.

H. Provide communications ports/modules for a data connection to allow for remote monitoring and programming.

I. Programmable through a personal computer. Ability to edit program as it runs.

J. Built in Ethernet port and serial communication port.

K. Minimum of 2 or 15% of the following spare inputs and outputs shall be provided, whichever number would be larger:

1. Digital inputs (each type used)
2. Digital outputs (each type used)
3. Analog input (each type used)

L. Diagnostic indicators for Run/CPU status, battery low, and status indicator for each I/O point.

M. Removable terminal blocks which accept up to 14 AWG wires for I/O wiring.

N. All I/O points, including spares, must be wired to terminal blocks. No field terminations may be made directly to the PLC Modules.

O. Provide surge protection for the PLC.

P. All digital I/O shall be 120V, with the exception of 0-10V pulse signals.

Q. All I/O which travels outside of the building shall have surge protection as follows:

1. I/O Surge Protection
   a. Analog surge protection shall be Phoenix Contact, DEHN, or equal.

b. VDC 24 discrete surge protection shall have 30V clamping voltage, 5kA surge current capacity, and 1nS response time; Phoenix Contact, DEHN, or equal.
c. VAC 120 discrete surge protection shall have 150V clamping voltage, 2.5kA surge current capacity, and 25nS response time; Phoenix Contact DEHN, or equal.

R. The PLC shall be listed by the manufacturer as an Active product at the time of submittal and shipment. Products identified by the manufacturer as Active Mature, End of Life, Discontinued, or equivalent lifecycle status shall not be acceptable.

S. Approved Manufacturer:

1. Allen Bradley CompactLogix Series

2.5 OPERATOR INTERFACE:

A. Shall be furnished and installed in the following panel:

1. Control Panel: Minimum 12”
2. Remote I/O Panel: Minimum 7”

B. Color touchscreen display.

C. On board memory with USB port for data storage and application backup.

D. 24VDC power.

E. Ethernet communication to PLC.

F. Manufacturer:

1. Allen-Bradley Panelview Plus 7
2. Or Equal from Maple Systems.

2.6 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Minimum size of 1000VA

B. Input and output voltage of 120VAC.

C. True on-line with spike, line noise, and RFI/EMI Filtering. Output shall be a true AC sine wave.

D. UL listed.

E. Battery sized to power 150 percent of the panel power requirements and all devices powered from the panel control circuits for 10 minutes.

1. Provide power calculations showing the required load with additional spare capacity during the submittal phase.

F. Surge protection shall pass ANSI/IEEE C62.41.

G. Operating temperature range 32 degrees to 113 degrees F.

H. Internal NO dry contact for remote status monitoring.

I. Provide a receptacle mounted on the backpanel near the bottom of the panel to plug in the UPS for input power. Provide a male plug end to plug into the output of the UPS of which provides power to the control devices and circuits.

J. Provide a relay at the load side of the UPS which will route the control power to bypass the UPS upon a UPS output failure.

K. Shall be set inside the control panel, at the bottom of the panel.

L. Manufacturer/Model:

1. Eaton Powerware

2. Or Equal.

2.7 CIRCUIT BREAKERS

A. All circuit breakers shall be UL labeled and shall be of the size shown. All breakers shall have an interrupting rating of not less than 35,000 amps sym. for 480V units, and 50,000 amps sym. For 240/208V units.

B. Manufacturer/Model:

1. Eaton/Cutler-Hammer
2. Square D
3. ABB
4. Prior approved equal

2.8 PHASE MONITOR

A. Sensing Voltage: as required for application

B. Din rail mounted.

C. Environmental:

1. Operation temperature: -25 to 55°C.
2. Storage temperature: -30 to 75°C.
3. Humidity (non-condensing) 0 to 90% RH.

D. Dry contact which activates upon loss of a power phase.

E. Manufacturer/Model:

1. Sycom Motorsaver
2. Littlefuse Motorsaver 460
3. Macromatic PMD Series
4. Or Equal.

2.9 CONTROL CIRCUIT SURGE PROTECTION DEVICE (SPD):

A. 120 VAC In-Line Device

B. Din rail mounted

C. L-L, L-PE, and N-PE protection.

D. Indication flags and voltage free contacts for remote status monitoring.

E. To be located ahead of the UPS, and downstream of the control circuit breaker.

F. Manufacturer/Model:

1. Erico
2. Edco
3. Pheonix Contact
4. Critiec
5. Or equal

2.10 POWER SUPPLIES 12 & 24VDC:

A. UL listed for use in UL 508 and UL 698 panels.

B. Line regulation 4% line variations from 105 to 132.

C. Load regulation 4% load variations from 0 to full load.

D. Not to exceed 100mv peak to peak on noise.

E. Hold time at max load shall be 16msecs.

F. Output current limited and overvoltage crowbar sensing circuit.

G. Output voltage adjustment.

H. DIN rail mountable.

I. The power supply shall provide surge protection, isolation and outage carry-over of up to 6 cycles of the AC line or 40ms at 24VDC.

J. AC input to the power supply shall be fused.

K. LED indicator to indicate it is powered on.

L. Power supplies shall be sized appropriately to handle the full load connected to them.

1. Provide an additional 50% spare capacity.

2. Power calculations showing the required load with additional spare capacity shall be provided during the submittal phase.

2.11 FUSE TERMINALS

A. DIN rail mounted, touch safe, modular type.

B. 250V RMS, amp rating as required for application.

C. Use ¼" x 1 ¼" standard fuses sized according to application.

D. Blown fuse indicator light.

E. Manufacturer/Model:

1. Allen Bradley

2. Phoenix Contact

3. Or Equal

2.12 MINIATURE CIRCUIT BREAKERS

A. UL489 Branch Protection

B. Utilize breakers with the C Trip Curve for medium inrush loads and D Trip Curve for higher inrush loads such as motors, etc.

C. 10,000 AIC Rating

D. Utilize 1-pole breakers within the control panels indicated below.

E. Breaker Status Indicator

F. Shall be furnished and installed in the following application(s):

1. 1-pole

a. Incoming Power Feed

b. Internal Panel Components

G. In addition to other circuit breakers required in the contract documents, provide a circuit breaker at the point incoming power is provided at the control panel. Provide another circuit breaker after the panel light and GFCI circuit to protect the control power circuit.

H. Manufacturer/Model:

1. Allen Bradley

2. Phoenix Contact TMC 8 Series
3. Eaton FAZ
4. Square D Multi 9
5. Or Equal.

2.13 CONTROL RELAYS:

A. Blade plug-in type with dust cover and socket.

B. Coil: continuous operation at 120 VAC ±10% unless required to be otherwise per the circuit it is used in.

C. Contacts, 3 pole, double throw, minimum.

1. 10 amps, make-break, 120 VAC. Resistive.
2. Insulation resistance: 1000 megohms at 500 VDC.
3. Dielectric: 2000 VAC, 60 Hz.

D. Operating time:

1. 35 milliseconds (nominal) energization.
2. 100 milliseconds (nominal) De-energization.

E. Mechanical life: 10^6 operations.

F. Temperature: 0° to 70°C

G. Manufacturer/Model:

1. Allen-Bradley
2. Idec
3. Pre-approved equal.

2.14 POWER RELAYS

A. Coil rating to work with control system power.

B. Contact rating which matches or exceeds the circuit's overcurrent protective device.

C. Approved Manufacturer:

1. Allen-Bradley
2. Square D
3. Pre-approved equal.

2.15 SELECTOR SWITCHES:

A. Heavy duty, 30.5 mm, oil tight units.

B. Selector switches with black knob type operator with white insert.

C. Contacts as needed for control scheme.

D. Approved Manufacturer:

1. Allen-Bradley 800T/H
2. Equal from Square D
3. Pre-approved equal.

2.16 PUSHBUTTONS:

A. Heavy duty, 30.5 mm, oil tight units.

B. Typically black operator, unless noted otherwise:

1. Red for pump stop.
2. Green for pump start.

C. Contacts as needed for control scheme.

D. Mushroom head style for emergency stop and chemical transfer.

1. Maintained position for emergency stop, red operator.
2. Spring return for chemical transfer, purple or blue operator.

E. Approved Manufacturer:

1. Allen-Bradley 800T/H
2. Equal from Square D
3. Pre-approved equal.

2.17 INDICATING LIGHTS

A. Heavy duty, 30.5 mm, oil tight units.

B. High visibility cluster LED.

C. Push-to-test type.

D. Lens color as specified, or red for 'fail/alarm', green for 'run', amber for 'called for'.

E. Approved Manufacturer:

1. Allen-Bradley 800T/H
2. Equal from Square D
3. Pre-approved equal.

2.18 GFCI RECEPTACLE

A. Provide 20A, 120V, GFCI receptacle near the bottom of the enclosure mounted on the back panel.

B. Receptacle shall be fed by a 10A min. circuit breaker powered from the control panel power circuit, ahead of the UPS.

2.19 CONTROL PANEL LIGHT KIT

A. Integrated automatic switch, spring-loaded, turning on when door is opened and shutting off when door is closed.

B. 120VAC with LED.

C. Provide two sets; one set for lighting work area on inner doors, and one set for lighting work area inside control panel.

2.20 IDENTIFICATION

A. Devices on the door exterior shall be identified with engraved phenolic tags which are engraved with white lettering on a black background and are attached with stainless steel screws.

B. Devices on interior doors shall be identified with engraved phenolic tags which are engraved with white lettering on a black background and are attached with stainless steel screws.

C. Devices mounted inside the panel shall be identified with embossed labels with adhesive backs as shown on the Contractor submitted wiring diagrams. Labels shall be on the mounting panel, near the device.

2.21 CONTROL PANEL WIRING:

A. Stranded copper conductors with color-coded 600-volt insulation.

B. Both ends of all conductors identified with wire tags which are numbered in accordance with the wiring diagrams, and which are protected with a clear, heat-shrinkable sleeve.

C. Complete wiring diagrams prepared specifically for this Site. All termination points shall be numbered.

D. Both ends of all conductors identified with wire tags which are numbered in accordance with the wiring diagrams, and which are protected with a clear, heat-shrinkable sleeve.

E. Provide enclosed wire ways in the panel.

1. Wireways shall be mounted parallel or perpendicular to panel enclosure lines.

2. Wire ways shall have removable covers, which do not require the use of tools.

F. All spare PLC inputs/outputs shall be wired to terminal blocks.

G. Provide separate terminal block grouping or segments for digital inputs, outputs, analog inputs and analog outputs.

H. Designated wire coloring shall be used to identify the function of the wire. Example, all digital input cabling shall be a designated color different than digital output wiring.

I. Terminal Blocks

1. DIN rail mounted, touch safe, modular type.

2. 600V RMS, 30 amps minimum or higher amp rating as required for application.

3. Connector metal body material: Copper alloy, min 85% copper with nickel or tin plating.

4. Terminal screw material: Bronze with tin plating.

5. Screw terminals on both side only. No other types shall be allowed.

6. Terminal block shall have the following characteristics:

a. It shall terminate wires without additional preparation: i.e. tinning of wire ends, application of ferrules, etc.

b. The insulation housing shall have primary entry funnels to facilitate insertion of wires.

c. The insulation housing shall prevent stray strands from shorting to adjacent terminal blocks.

d. The termination shall be gastight to prevent corrosion due to corrosive atmospheres.

e. Terminal screws shall be captive in the metal body or via the insulation housing.

f. Once tightened the terminal screws shall be locked in place to prevent loosening due to shock and vibration.

g. The terminal block shall be useable with accessories such as center or insertion bridges; test sockets; separating plates; and end covers, etc. The accessories used shall also be touch safe.

h. For wire identification, the terminal block shall provide space for marking with pre-marked labels. Handwritten labels shall not be allowed.

7. Manufacturer/Model:

a. Allen Bradley 1492-J4

b. Phoenix Contact UT 4

c. ABB

d. Or Equal

2.22 CONTROL PANEL MANAGED ETHERNET SWITCH

A. Performance:

1. Managed operation.
2. Store & Forward wire speed switching.
3. Automatic sensing speed and flow control.
4. Ring network topology capability.

B. Ports:

1. Minimum of six (6) 10/100/1000 RJ45 Copper Ports.
2. Minimum of four (4) 100/1000 SFP Ports.

C. Power Input:

1. 9.6-60 VDC.
2. Redundant input terminals.

D. Environmental:

1. Operation temperature: -40 to 140 °F.
2. Storage temperature: -40 to 185 °F.
3. Humidity (non-condensing) 10 to 95% RH.

E. Provide Din Rail mounting kit

F. Provide Power Supply (PWR-IE50W-AC)

G. Licensing:

1. Does not require Owner to hold or maintain a license to for the switch to operate. A switch which will require re-occurring renewals and fees by Owner will not be accepted.

H. Manufacturer/Model:

1. Allen Bradley,
2. N-TRON,
3. Moxa,
4. Or Equal.

2.23 CONTROL PANEL FIREWALL

A. Enhanced security capabilities such as deep packet inspection (DPI) technology, to detect, prevent, and/or respond to potentially malicious traffic.

B. Informed decision-making with Cisco ASA and FirePOWER technologies for threat detection and prevention capabilities based on configured security policies.

C. Industrially hardened, DIN-rail mountable platform.

D. Licensing:

1. Does not require Owner to hold or maintain a license to for the firewall to operate. A firewall which will require re-occurring renewals and fees by Owner will not be accepted.

E. Approved Manufacturer:

1. Allen Bradly Stratix 5950 Security Appliance
2. Or Equal.

2.24 NETWORK RACK AND RACK COMPONENTS

A. Wall mount Network Rack and Accessories

1. EIA-standard 19” Low-Profile Switch-Depth enclosure to field mount network equipment. Minimum 10 rack units or as required for selected equipment.
2. Rack to have option to swing away from the wall on a hinge for easy front and back door access.
3. Heavy duty steel with black powder-coated finish.
4. Maximum load capacity of 200 lbs.
5. Ground studs on front and back door frames.
6. Ground kit.
7. Manufacturer:
    a. Eaton Tripp-Lite SmartRack Series,
    b. Or equal.
8. Contractor is responsible for verification of compatibility for all rack accessories with vendor.

B. Rackmount Ethernet Switch
1. Full compliance with IEEE 802.3.
2. General Specifications:
    a. 10/100/1000Base-TX Ports: 8 PoE
    b. SFP Ports: Four (4) 100/1000 SFP Ports
3. Management: Serial interface, web interface.
4. Diagnostics:
    a. LEDs (Power, Link Status, Data, Fault, redundancy manager).
    b. RMON (statistics, history, alarms, events).
    c. Port mirroring.
5. Configuration: Terminal software, BootP, DHCP.
6. Security:
    a. Security features based on IEC 62443 standard.
7. Other Services:
    a. Port prioritization (IEEE 802.1D/p).
    b. VLAN (802.1Q).
    c. Multicast.
    d. Broadcast limiter.
    e. Flow Control (IEEE 802.3x SNTP).
8. Power: 120VDC.
9. Operating Temperature: 0 to 60 degrees C.
10. Licensing:
    a. Does not require Owner to hold or maintain a license to for the switch to operate. A switch which will require re-occurring renewals and fees by Owner will not be accepted.
11. Manufacturer:
    a. Moxa,
    b. Hirschmann,

c. Or equal.

C. Network Rack Enclosure Mounted Power Distribution Unit (PDU)

1. Mount inside wall mounted enclosure
2. Power on/off LED.
3. External ground stud.
4. Integral circuit protection (breaker) with reset button.
5. Surge protection.
6. Molded power cord with plug.
7. Rack mounted in 1RU space.
8. (2) front, (6) back NEMA 5-15R receptacles.
9. Manufacturer:
    a. Eaton Tripp-Lite,
    b. Pentair,
    c. Or equal.

D. Network Enclosure Mounted Smart Uninterruptible Power Supply (UPS)

1. Rack mounted in 2RU space.
2. 900VA minimum or larger if indicated.
3. 97 percent efficiency at full load.
4. (6) NEMA 5-15R receptacles.
5. Molded power cord with plug.
6. Maintenance free sealed lead-acid batteries with suspended electrolyte. Leak-proof.
7. Communications and management interface ports: USB.
8. LCD display.
9. Manufacturer:
    a. APC Smart UPS RM SMT,
    b. Or equal.

E. Network Mounted Fiber Patch Panel

1. Rack mounted in 1RU space.
2. 6-SC ports.
3. 16-gauge steel painted black.
4. Factor configured for polarity method A.
5. Low insertion loss of 0.15db.

F. Fiber Patch Cords

1. Pre-assembled end connections: SC-SC.
2. Fiber type: Multimode to match distribution fiber cables.
3. Fiber Count: 2.
4. Length: As required with minimum of 36 inches.

5. Manufacturer:
    a. Corning Cable Systems LLC,
    b. Or equal.
6. For each patch panel, provide patch cords for the number required for active use and 2 additional spare patch cords.

G. Category 6 Ethernet Patch Cable
1. Factory constructed UTP patch cables to be used for connections between switches and PLCs, OITs, Network Switches, and Network Rack Patch Panels.
2. Furnish resilient Category 6 UTP patch cables with braided wire. Molded boots with strain relief that support 1,000 unplugging cycles.
3. Length – Custom.
4. RJ-45 connector ends.
5. Manufacturer:
    a. Belden,
    b. Panduit,
    c. Lucent,
    d. Or equal.

2.25 WIRELESS ROUTER

A. IEEE 802.11 compliant device, multi-SSID operation. Unit shall operate using Power-Over Ethernet (POE) design.

B. Provide high-gain antennas and cables at each of requested locations:
1. Hall and Office rooms to be covered with Wi-Fi signal.

C. Manufacturer:
1. TP-Link Technologies Company,
2. NetGear,
3. Or equal.

2.26 SCADA PC

A. An allowance shall be reserved for the purchase of one desktop PC, 2 monitors, modems, surge strips, and a UPS for the PC.

B. The newest versions of Windows Operating System, Anti-Virus, and Microsoft Office Suite Software shall be considered as included in this allowance.

C. This amount is totally available to the Owner.

D. The Contractor shall completely coordinate the selection, ordering, and delivery of the equipment. The hardware shall not be purchased until the time when the Control System Integrator is ready to load the SCADA Software and commence programming. The Contractor shall submit a bill of materials and invoice from the computer manufacturer (i.e. HP, Dell, etc.) for approval prior to purchasing the hardware.

E. The allowance shall be used to cover the cost of the hardware, sales tax, and delivery. If the cost is less than the allowance, the difference shall be credited to the Owner in the form of a Deduct Change Order. The actual invoice shall be submitted after purchase to verify hardware costs.

F. Any costs for equipment installation labor, set up, cables, connectors, overhead and profit, and all other equipment necessary for a complete and functional installation is to be figured over and above the allowance amount.

G. Actual hardware purchased will vary with what is readily available at the time of purchase, but in general, the allowances will be used to purchase the following:

1. Computers (HP, Dell, or approved equal) with the following features:
   a. Windows 11 Pro operating system. Complete with Microsoft Office Word and Excel.
   b. Anti-Virus Software: Coordinate software preference with Owner at time of Order.
   c. Firewall Software: Coordinate software preference with Owner at time of Order.
   d. Remote Communications Software: To be provided by Control System Integrator.
   e. Intel based processor. Clock speed, bandwidth, number of cores and cache size shall be consistent with latest technology at time of order.
   f. NVIDIA GTX 1080 or better graphics card as recommend by the SCADA software specifications.
   g. 4TB SATA hard drive.
   h. USB, parallel and serial ports as required.
   i. Mouse and enhanced soft click keyboard.
   j. Ethernet network interface card.
   k. Speakers, sound card, and related appurtenances as required.

2. Flat Panel Monitors:
   a. 27” LED backlit.
   b. Anti-glare coating.
   c. Energy Star compliant.

3. 1 surge protection strip with on/off switch, 6-foot cord, 6 output receptacles, telephone jack for modem, resettable over current protection and plastic case.

4. 1 uninterruptible power supply sized for 15 minutes of operation, internal bypass, and alarm output contact: Best Fortress, MGE EX Series, or equal.

H. All SCADA software to be provided and installed by Control Systems Integrator under the lump sum bid items.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Control panels shall be secured to concrete pad using stainless steel hardware.

B. Panels shall be constructed using fabrication techniques that allow for removal and maintenance of all equipment after installation without removal of unrelated components.

C. Contractor shall provide all hardware required to install equipment. The Contractor shall review the wiring diagrams for the equipment furnished and modify the wiring to conform to the requirements of the equipment furnished. The Contractor shall not be compensated for extra labor and materials, which are required to change wiring which was not confirmed with the equipment manufacturer’s drawings.

D. All programmable devices shall be completely programmed by the Contractor. This shall include modification in the field to obtain the mode of operation as specified herein. Programming shall be done in such a manner as to allow complete access to the program in the future by the Owner for changes and or additions. Program locks shall not be used.

E. Install wiring between equipment and remote devices as specified and as required for the control specified in other sections.

3.2 CONTROL PANEL

A. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer’s recommendations.

B. All wiring within the enclosure shall be through the plastic wiring ducts with maximum 60% fill. All wiring not in ducts shall be in plastic spiral bindings. All I/O devices shall be wired to rail mounted terminal blocks.

C. All field wiring shall terminate at the rail mounted terminal blocks that shall be mounted either at the bottom or on the side of the enclosure back panel depending on where the I/O conduits penetrate the enclosure.

D. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired.

E. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer.

F. Install all the system equipment including PLCs and interconnecting cabling as required. This work shall include all interconnection wiring from new and existing equipment as required for the completion of the system.

G. It shall be the responsibility of Contractor to ascertain that all field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:

1. Equipment size and available space.
2. Power levels.
3. Power sources.
4. Logic schemes.
5. Signal types and levels.
6. Interface devices where required.
7. All other aspects of field devices impacting on the design of the system.

H. All spare and unused I/O shall be wired to terminal strips. This wiring shall include all auxiliary devices and components to complete the installation (e.g., interposing relays, wireways).

I. It shall be the responsibility of Contractor to include all the inputs and outputs required to maintain existing functionality and to meet all aspects of this specification, regardless of whether they are specifically included in the I/O listing in this specification.

3.3 SCADA SYSTEM PROGRAMMING

A. All programmable devices shall be completely programmed by the Control Systems Integrator. This shall include modification in the field to obtain the mode of operation as specified herein. Programming shall be done in such a manner as to allow complete access to the program in the future by the Owner for changes and or additions. Program locks shall not be used.

B. Control Systems Integrator shall program the variable speed motor controllers and all other programable devices per the Contract Documents, manufacturer's instructions and in coordination with other trades so that a complete and functional system is delivered.

C. PLC's, OIT's and SCADA software is to be programmed by the Control Systems Integrator

D. Intent is for SCADA PC and OIT screens to have the same screens which operate the same.

E. In the event the any site loses connection to the internet, the control system at the site and the rest of the SCADA system shall remain operational.

F. PLC's shall remain operational at all times, even if the graphical interfaces and/or SCADA PC would fail.

G. All programming shall be performed using the Control System Integrator programming licenses. The Owner will not be providing software licenses for programming.

H. Control Systems Integrator shall setup and program all communication equipment, including but not limited to, switches, routers, media convertors and firewalls.

I. A copy of the complete PLC programs shall be saved on the respective PLC memory card.

J. The PLC's shall be programmed to retain setpoint and other critical data so that the PLC will automatically resume the process controls when power is restored to the panel after a power failure.

K. SCADA system shall be designed and programmed to operate without the use of either the SCADA PC or HMI. Meaning, programming, data processing, control loops, algorithms and other programming features shall reside on the PLC. If the SCADA PC is off or not operating, or the SCADA HMI is not operating, the SCADA system shall still operate as specified.

L. Display the call, run, fail, position and other status points of each piece of equipment and alarms for the associated equipment.

M. Screen(s) shall allow the operator to adjust all variables and view real-time data associated with the process control and equipment.

N. Screens(s) shall display alarms and allow the operator to acknowledge the alarms at any location.

O. Provide screens required for the system operations as specified in Contract Documents.

3.4 SCADA SCREENS

A. SCADA screens shall be set up using graphical representations of the actual equipment. The graphics shall be of the latest graphic package from the SCADA software manufacturer. Custom graphics will be allowed and shall be provided where a software graphic is not provided, and shall be of same quality, resolution, and style as the latest graphic package from the SCADA software manufacturer.

B. SCADA screens shall be programmed and set up to follow the ISA-101 HMI standards for high performance displays.

1. All backgrounds shall be a light gray color. Background color shall be reserved for background only. Backgrounds shall not contain additional graphics or colors.

2. Process lines shall consist of a single line which changes color to depict flow, and flow alarms.

3. Lines used to connect data points to objects shall be dashed lines and gray in color.

4. Bright colors shall be used for warnings or alarms.

a. Alarms – Red

b. Warning – Yellow

C. Provide an overview screen which shows a bar graph for the below levels. The bar graph shall be thin with a sliding arrow indicating the active level. Arrows shall be on the left side of the graph; the right side of the graph shall display tick marks representing different levels.

1. Graph shape/lines shall be a gray color, darker than the background.

2. The sliding triangle shall be a dark blue color.

3. Normal static operating range shall be light blue fill on the graph.

4. Warning and alarm ranges shall be darker shades of gray, warning shade lighter than alarm. When the measure level enters the warning or alarm area, the shade of fill shall change to the associated assigned bright color.

5. The measured value shall be displayed directly under the graph. Underneath this shall be the units of measurement.

6. The graph shall be labeled above the graph with the site and process being displayed.

7. All status points and setpoints available for the entire wastewater system

8. Trends page – operator may select and choose which data items to be trended and adjust the X&Y scales.

9. Alarm settings page

10. Alarm dialing software settings.
11. Active Alarm page
12. Alarm history page
13. Page to add or remove operators and assign personalized passcodes.
14. Customizable Reports:
    a. Daily, monthly, and annual run time reports for each site.
    b. Daily, monthly, and annual flow total reports for each site and total system.
    c. Daily, monthly, and annual tank and reservoir levels reports.
    d. Control System Integrator shall provide up to 4 additional reports and coordinate report information and layouts with City.

3.5 SYSTEM TESTING

A. All components of the system shall be thoroughly simulated and tested in the control supplier's facility prior to shipment.
   1. Contractor shall provide testing approval certification from the panel manufacturer prior to receiving shipment.

B. On Site Testing:
   1. Verify that each instrumentation and control device is wired and operating correctly. Owner control system programmer will provide "online" PLC testing of each field device, and coordinate with Contractor the proper operation of each instrumentation and control device.
   2. Provide services of a factory-trained person to checkout, test, and commission the system on Site.
   3. Place equipment into service and provide operation as specified.
   4. Provide actual activation of each control function and alarm in the system. If actual activation is not possible, the function shall be simulated.
   5. 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.

3.6 SYSTEM COMMISSIONING & DEMONSTRATION

A. Upon completion of the Contractor's acceptance checks, settings, and tests, the Contractor shall demonstrate that the equipment is in good operating condition and properly performing the intended function.

B. Process Engineer will witness operational tests and instruct programmers to adjust setpoints to achieve the operation desired by the Process Engineer.

C. Contractor shall have system programmer at site for the commissioning process.

D. A minimum 2-week notice will be provided to the Contractor for scheduling of commissioning dates.

E. If Contractor has not completed programing and system tests prior to the system commission and demonstration, Contractor shall reschedule the demonstration at Contractor's expense.

3.7 OPERATOR TRAINING

A. Control Systems Integrator shall provide operator training.

B. System commission and demonstration shall be completed before factory-trained personnel instruct the operating personnel.

C. Training for each site shall be not less than two 2-hours. Each site session may be broken into 2 separate dates if selected by the Owner.

D. Training time specified shall be time spent at the Site training staff and shall not include travel time.

E. Training time does not include startup, testing, demonstration, and time used for system modifications.

F. Provide a training manual outlining all control and procedural operations.

G. Contractor shall include 16 hours of training.

3.8 ADDITIONAL PROGRAMMING MODIFICATIONS

A. If during construction, Engineer directs control integrations programmer to make changes to the control programing which are not outlined above and Contractor feels additional programming time over and beyond the base bid controls specified above, Contractor shall submit a Change Order proposal for the programming time he/she feels is required to make the suggested modifications.

B. Contractor shall not make programming modifications which he/she feels is outside the scope of work unless Contractor's Change Order has been approved by Engineer/Owner. Work done prior to approval of such Change Order request will not be retroactively awarded to Contractor.

C. The contractor shall provide an additional 80 hours of programming time to occur in the field after equipment has been installed, over the base bid programming mount. The first 40 hours will be credited to Contractor Change Order request forms upon approval of the request by Owner/Engineer. Time not documented in such a manner will not be acknowledged as additional programming time needed and will be considered as base bid programming time.

3.9 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components.

B. Provide warning signs as required by the NEC and where noted in the specifications.

C. Label each enclosure-mounted control and pilot device.

D. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.

END OF SECTION

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SECTION 28 42 00 - TOXIC AND COMBUSTIBLE GAS DETECTOR

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install toxic and combustible gas detection equipment in the Sludge Building Lower Level areas as shown on the plans, described in these specifications, and as required to provide complete and operative gas detection systems.

B. The gas detection systems shall be single-point, three-gas systems designed for the detection of hydrogen sulfide, oxygen, and combustible gas.

C. Chlorine and sulfur dioxide gas detectors are specified in Section 46 31 00 - Chlorination and Dechlorination Equipment.

1.2 RELATED SECTIONS

A. Division 26 - Electrical

B. Section 46 31 00 - Chlorination and Dechlorination Equipment

1.3 SUBMITTALS

A. The Contractor shall submit shop drawings and manufacturers' literature for all items furnished under this section.

B. Complete operation and maintenance instructions shall also be submitted.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Each gas detection system shall consist of one hydrogen sulfide sensor/transmitter, one combustible gas sensor/transmitter, one oxygen sensor/transmitter, and a receiver for displaying and alarming any gas buildup, alarm horn, and flashing red light, and all interconnecting wiring and miscellaneous hardware.

2.2 ACCEPTABLE MANUFACTURERS

A. MSA Instruments

B. Enterra Instrumentation Technologies

2.3 SENSORS

A. The gas sensors shall be electrochemical gas diffusion sensors designed to measure gas concentrations over the following ranges:

Oxygen Deficiency Sensors	0-25%
Hydrogen Sulfide Sensors	0-100 ppm
Methane	0-100% LEL

B. The sensors shall be maintenance-free and not require the use of a sample pump or regular changing of membranes or electrolytes in order to operate. The sensor shall be threaded into a transmitter

housing and wired into an electronics block within the housing which will amplify and condition signals for transmission to the receiver.

C. The sensor body and flame arrestor on the combustible gas unit shall be manufactured entirely of 316 stainless steel and shall be constructed of two parts to allow the replacement of detector elements. The sensor/transmitter shall be Factory Mutual approved for use in Class 1, Division 1, Groups B, C, and D areas.

D. The sensors shall be wall-mounted and be contained in a corrosion-resistant enclosure.

2.4 RECEIVER

A. A multi-channel receiver shall be provided to accept and process the signal from each sensor and display the output. The receiver shall be wall mounted in a NEMA 4X corrosion-resistant enclosure and contain relays for warn, alarm, horn and fail.

B. The receiver shall accept the signal from the transmitter and gas concentration shall be displayed on a bright LED display with automatic range change for the gas being measured.

C. The receiver shall allow for automatic or manual display scanning of the sensor inputs.

D. Two adjustable alarm setpoints shall be provided for each gas. The alarm setpoints shall be displayed when the associated sensor switch on the front panel is pressed. Setpoints shall be adjustable from 5% to 100% of the range.

E. An output shall be provided for each setpoint. The warning output shall be non-latching and the high alarm output shall be latching, resettable from the front panel.

F. A horn output shall operate in conjunction with the alarm output and shall be silenced by a reset button on the front panel.

G. Contact closures shall be provided for separate warning and alarm circuits which shall actuate an external alarm horn and flashing red light mounted on the exterior of the building.

H. A light on the front panel shall indicate a malfunction condition.

I. The receiver shall be powered by 120 VAC, 60 Hz, single-phase current.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All items shall be installed in accordance with the manufacturer’s recommendations, instructions, and directions.

B. Alarm horn and flashing red light shall be installed on the exterior of each monitored area.

C. Start-Up Services

1. The equipment supplied shall provide one-half (1/2) day service by qualified service personnel to inspect the completed installation and to instruct the owner’s personnel in the proper operation and maintenance of the equipment.

**** END OF SECTION ****

SECTION 31 11 00 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to clearing and grubbing trees, stumps, and brush as indicated on the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Measurement and compensation for the following items will be paid according to the referenced specification or as modified below:

1. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section will be included in the Lump Sum bid for the project or appropriate bidding section.

2. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. MnDOT 2101 will apply to this Section.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. No submittals for this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. No exception to this section is made.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Tree clearing will be limited to November 1 to March 31, inclusive.

B. Tree clearing seasonal restrictions do not apply to grubbing.

C. Before tree trimming to remove overhanging branches, the Contractor shall inspect the branches to be trimmed for occupied bird nests and/or hollows that may be used by birds or bats.

1. If absent, tree trimming will be completed without time restrictions.

D. If present, the Contractor shall document with photos to the best of their ability and contact the Engineer before initiating tree trimming. Tree trimming may not proceed until authorized in writing by the Engineer

E. All trees, stumps, brush, seed, grass, roots, or other undesirable material within the construction limits will be disposed of by the Contractor.

F. Disposal methods will be approved by the Engineer and shall meet all Local, State, and Federal regulations.

G. Burning or burial will not be allowed within city limits.

******END OF SECTION******

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SECTION 31 23 00 - EXCAVATING AND BACKFILLING FOR STRUCTURES

PART 1 -- GENERAL

1.1 WORK INCLUDED

A. Topsoil Removal

B. Excavation

C. Pipeline Trench Excavation

D. Sand Backfill and Engineered Fill

E. Compacted Aggregate Bedding

F. Drain Rock

G. Random Backfill

H. Pipeline Trench Backfill

I. Excess Materials

J. Subgrade and Backfill Tests

K. Cutting and Restoring Existing Surfaces.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 32 10 00 - Roads, Walks, and Curbs

C. Section 33 00 00 - Site Utilities

D. Section 40 23 00 - Process Pipes and Pipe Fittings

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

1. ASTM D 422 - Method for Particle-Size Analysis of Soils

2. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. (2.49-kg) Rammer and 12-in. (304.8-mm) Drop.

3. ASTM D 1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.

4. ASTM D 1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.54-kg) Rammer and 18-in. (457-mm) Drop.

5. ASTM D 2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

6. ASTM D 2487 - Classification of Soils for Engineering Purposes.

7. ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

8. ASTM D 4254 - Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.

9. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

B. Specifications

1. The State of Minnesota, Department of Highways, "Standard Specifications for Construction," 2020 Edition, and Current Supplemental Specifications for Construction Divisions II & III, shall govern. The numbers shown in parenthesis in the following Special Provisions refer to the Section of the governing specifications.

2. "Standard Utilities Specifications for Watermain and Sanitary Sewer and Storm Sewer Installation," as prepared and published by the City Engineers Association of Minnesota, dated 2018, shall apply to construction in this contract except as modified or altered in these Special Provisions and are referred to as CEAM Specifications.

PART 2 -- PRODUCTS

2.1 TOPSOIL REMOVAL

A. Topsoil shall be removed from the area to be excavated for the structures, construction of embankments, and/or within the grading limits of the project. The excavated topsoil shall be stored on the site for reuse. Stockpile shall not be located where it will interfere with other phases of the project or create a danger to public safety.

B. All brush, weeds, grass, roots, or other undesirable material shall be disposed of by the Contractor.

C. Care shall be exercised in salvaging the topsoil so that the material is reasonably free of subsoil, stones (greater than two inches in diameter), and other undesirable materials. All seeded and sodden areas shall receive 4 inches of topsoil. If salvaged and stockpiled topsoil is insufficient, then the CONTRACTOR shall provide additional topsoil at no extra cost to the OWNER.

2.2 EXCAVATION

A. Contractor shall excavate to the lines and grades as shown on the plans and as noted in this specification. The excavation shall be no larger than safety requires, permit adequate inspection, and permit the construction of various contiguous components of the basic structure. All areas of the plant site to be covered by fills, structures, or roads shall be stripped to a minimum depth of three inches or to deeper depths to remove any grasses, roots, or any remaining vegetation.

B. Contractor shall remove old foundations, boulders, or other undesirable material encountered during the excavation process.

C. Excavated materials shall be stored on the site in a location that permits construction to proceed. Excess excavated material or material that cannot be conveniently stockpiled on the site shall be removed to a location selected by the OWNER and shall then be returned to the site as necessary to be used as random backfill.

D. Excavation shall be sloped or otherwise supported in a safe manner in accordance with applicable State and Federal industrial safety requirements.

E. Excavation in rock or other unyielding material shall be carried to a depth of not less than 6 inches below the grade required. The excavation will then be brought back to grade with granular backfill and compacted in accordance with this specification.

F. However, if the subgrade material becomes soft or unsuitable through the Contractor's negligence, the undesirable material shall be excavated. The excavated area shall then be filled with granular material and compacted in accordance with this specification.

G. Contractor shall excavate all material for structures to a depth of 12 inches below the bottom of the structure elevations shown on the plans. Oversize excavation one foot horizontally beyond the footing slab for each foot vertically that the excavation is below the footing.

H. The area shall be protected from surface runoff. Pumps and related appurtenances shall be readily available to remove excess water. Standing water will not be permitted in the excavation. Temporary ditches or drains shall be constructed to control surface water and protect the site.

I. The Engineer shall be notified when the site is ready for footings, slabs, etc., in ample time for Engineer to inspect the prepared area.

J. The excavated "bearing area" shall be protected from frost. Concrete shall not be poured on frozen subgrade.

K. If an unexpected soft or yielding subgrade is encountered in the site at the required subgrade elevation, the Engineer shall be notified.

L. Upon completion of the excavation as described, the Contractor shall notify the Engineer that the foundation soils are ready for testing.

M. During cold weather, excavate to expose only as much foundation soil as possible to protect from freezing. Fill material shall not be placed over frozen materials.

N. If natural clays are present at the foundation level, excavation work must be undertaken carefully to minimize disturbance due to moisture, construction equipment, and foot traffic. If any soils become disturbed, they shall be removed prior to placing fill material or constructing foundation elements.

O. No direct compensation will be paid for structural excavation. The cost for structural excavation shall be included in the lump sum bid.

2.3 GRANULAR BACKFILL AND ENGINEERED FILL

A. Water from areas to receive granular backfill shall be removed before commencing work, and areas shall be kept free of water during filling and compaction. All topsoil and organic materials in any area to receive Engineered Fill or granular fill shall be removed to a minimum depth of 12 inches.

B. Where footings, concrete floor slabs, or structures are to be supported on Engineered Fill or granular fill, the entire surface of the fill area shall be smoothed, leveled, and compacted using heavy vibratory equipment until there is no loss of elevation. The sand fill material shall be placed in 6" deep lifts and compacted to at least 100% of the maximum density given by ASTM D698 (Standard Proctor Density). The fill shall extend beyond the edges of the structure, one foot for each foot of fill placed below the structure. The compacted lift shall be relatively smooth and level.

C. Frozen material or material containing ice or snow shall not be used for fill. Sand fill shall not be placed on soil that is frozen or covered with ice or snow. Necessary precautions shall be taken during freezing weather to prevent freezing of the sand fill during placing and compaction.

D. All debris shall be removed from the excavated areas before backfilling.

E. Excavations shall be promptly backfilled as work permits. Foundation walls or tank walls shall not be backfilled until the respective walls have achieved full design strength. The walls shall be adequately shored prior to backfilling.

F. The excavated area outside of the building foundation walls and the walls of all tanks shall be filled with granular fill. Unless otherwise noted, the fill area shall be defined by a line 30° from the vertical plane, starting at a point at the base of the foundation. Granular fill shall be placed in 6-inch deep lifts, and each lift shall be compacted by approved methods to not less than 100 percent of Standard Proctor Density beneath structures; 98% of Standard Proctor Density beneath roadways, walks, or paved areas; and 95 percent of Standard Proctor Density around the sides of structures. Compacted lifts shall be relatively smooth and level.

G. The backfill shall be tested for proper density in accordance with paragraph 2.8 “Subgrade and Backfill Tests” of this section. After the recommendations of the soil testing laboratory have been reviewed by the Engineer, the work may proceed.

H. The granular fill to be used for backfilling shall be an SW clean well-graded sand (Unified Soil Classification System), free of organic impurities. The well-graded sand shall have less than 40% passing the No. 40 sieve and less than 5% passing the #200 sieve with the maximum aggregate size of 1-1/2”.

I. The Contractor shall furnish gradation tests at their expense for all fill material prior to use from an independent testing laboratory. The testing laboratory reports shall be reviewed and approved before the material is placed. Should the material being placed be different than previously tested, the Contractor shall furnish additional gradation tests.

J. Sand backfill around building walls shall be capped with a one-foot minimum layer of clay and sloped away from the structure to provide good drainage.

K. If the Contractor is in doubt as to the bearing capacity of the soil at the bottom of the footings or other work, he shall notify the Engineer before proceeding with his work. By failing to do this, he shall be responsible for any damage to the structure due to settlement.

2.4 COMPACTED AGGREGATE BEDDING

A. Following site preparation and excavation, a layer of aggregate bedding, 12 inches in thickness, shall be placed under all structures. Compacted aggregate bedding shall extend laterally beyond the edges of footings, one foot for each foot of fill placed.

B. Compacted aggregate bedding for well-draining soils shall be a well-graded mineral product and conform to the following gradation requirements.

Sieve Size	Percent Passing
1 inch	100
3/4-inch	90-100
3/8-inch	50-90
No. 4	35-80
No. 10	20-65
No. 40	10-35
No. 200	3-10

C. The compacted aggregate bedding shall be thoroughly moistened and compacted with at least two passes using an approved plate or roller-type vibratory compacting equipment to 98 percent of Standard Proctor Density.

D. The aggregate bedding for poor draining clayey soil shall be a free-draining mineral product, excluding crushed carbonate quarry rock, crushed concrete, and salvaged bituminous mixture, and conform to the following gradation requirements.

Sieve Size	Percent Passing
1”	100
3/4”	85-100
3/8”	30-60
No. 4	0-10

E. After placement of the bedding material, the entire area shall receive at least two passes from approved plate-type vibratory compaction equipment.

2.5 DRAIN ROCK

A. Drain rock shall be a free-draining mineral product, excluding crushed carbonate quarry rock, crushed concrete, and salvaged bituminous mixture, and conform to the following gradation requirements.

Sieve Size	Percent Passing
1”	100
3/4”	85-100
3/8”	30-60
No. 4	0-10

2.6 RANDOM BACKFILL

A. Select material removed during excavation shall be used for backfilling the outside walls of the structures above the original grade where both sides of walls are backfilled. Where the interior is open (basement or tank) granular backfill shall be used. This material shall also be used to raise the grade of the site to the planned subgrade elevation where required.

B. Water shall be removed from areas to receive backfill before commencing work, and areas shall be kept free of water during filling and compaction.

C. Frozen material containing ice or snow shall not be used for fill. Fill material shall not be placed on soil that is frozen or covered with ice or snow. Necessary precautions shall be taken during freezing weather to prevent freezing of fill during placing and compaction.

D. Except where otherwise specified for a particular structure or ordered by the Engineer, backfill placed around and beneath structures and beneath paved areas shall be placed in horizontal layers not to exceed 8 inches in thickness, as measured before compaction, where compaction is attained by means of sheepsfoot rollers. Where the use of sheepsfoot rollers is impractical, the layers shall not exceed 6 inches by thickness before compaction, and compaction shall be attained by means of hand-operated power-driven tampers. The backfill shall be brought up evenly with each layer moistened and compacted by mechanical means to 100 percent of Standard Proctor Density beneath structures; 98% of Standard Proctor Density beneath roadways, walks, or paved areas; and 95 percent of Standard Proctor Density around the sides of structures.

2.7 EXCESS MATERIAL

A. All excess topsoil shall remain the property of the CONTRACTOR and shall be disposed of by the CONTRACTOR at the CONTRACTOR’S expense.

B. Excess excavated earth shall be disposed of by the CONTRACTOR unless otherwise specified. The waste area shall be leveled to conform to the adjacent topography and graded to shed surface water.

2.8 SUBGRADE AND BACKFILL TESTS

A. Where backfill is required to be compacted to a specified density, tests for compliance may be made by the Engineer, at the expense of the OWNER, using the test procedure prescribed by the "Standard Test Methods for Moisture-Density Relations of Soils Using a 5.5 lb. Rammer and 12-inch Drop" (ASTM D698).

B. Field density tests shall be performed in accordance with the test procedure specified in "Standard Test Methods for Density of Soil in Place by the Sand Cone Method" (ASTM D1556) or "Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)" (ASTM D2922).

C. Sufficient time shall be allotted to the Engineer for performing the necessary control tests for an acceptance of the compacted layer before attempting to place new fill material. Any layer or portion thereof that does not meet density requirements shall be reworked and re-compacted until it meets the specified density requirements as determined by the Engineer.

D. Additional tests made as a result of non-compliance shall be at the Contractor's expense.

E. The Engineer may conduct field tests to evaluate the soil-bearing capacity for all footing excavations. The Contractor shall notify the Engineer when the footing excavation is completed and shall give the Engineer ample time for the performance of the bearing capacity tests prior to continuation with construction.

2.9 CUTTING AND RESTORING EXISTING SURFACES

A. All pavement surfaces consisting of streets, driveways, alleys, etc., destroyed in connection with performing the work required under the contract shall be replaced with the same kind or better by the Contractor. The Work shall be done according to MnDOT, and CEAM specifications.

B. For a period of two (2) years following the date of acceptance of the work by the OWNER's governing body, the Contractor shall promptly patch, maintain, repair, and/or replace any pavement, curb, or sidewalk which settles or becomes damaged due to settlement or defective materials or workmanship. If a serious settlement has occurred, the pavement, curb, or sidewalk shall be removed and the sub-base and/or base course restored to the proper grade before restoration of the surface course.

C. All damages or claims resulting from improper maintenance of the roadway shall be borne entirely by the Contractor.

PART 3 -- EXECUTION

3.1 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

A. **General:** Except when specifically provided to the contrary, the excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. The removal of said materials shall conform to the lines and grades shown or ordered. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The CONTRACTOR shall furnish, place and maintain all supports and shoring that may be required for the sides of the excavations and all pumping, ditching, or other measures for the removal or exclusion of water, including taking care

of stormwater, groundwater, and wastewater reaching the site of the work from any source as to prevent damage to the work or adjoining property. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

3.2 EXCAVATION IN THE VICINITY OF TREES

A. Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without the express permission of the ENGINEER. Trees shall be supported during excavation by any means previously reviewed by the ENGINEER.

3.3 BACKFILL - GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfilling is being placed.

B. Except for drain rock materials being placed in over-excavated areas or trenches, the backfill shall be placed after all water is removed from the excavation.

3.4 BACKFILLING UNDER PIPE

A. All trenches shall be backfilled by hand from the bottom of the trenches to the centerline of the pipe with granular backfill material placed in 3-inch layers and compacted by tamping. Backfilling material shall be deposited in trenches for the full width on each side of the pipe, fittings, and appurtenances simultaneously.

3.5 BACKFILLING OVER PIPE

A. From the centerline of pipe, fittings, and appurtenances to a depth of one foot above the top of the pipe, trenches shall be backfilled by hand or by approved mechanical methods. The CONTRACTOR shall use special care in placing this portion of the backfill so as to avoid damaging or moving the pipe.

3.6 BACKFILLING TO GRADE

A. From one foot above the pipe to the grade shown in the drawings or specified herein, trenches shall be backfilled by hand or by approved mechanical methods.

3.7 BACKFILL UNDER EXISTING OR PROPOSED PAVEMENT, UTILITIES, OR WALKS

A. Where the excavation is made through existing or proposed pavements, curbs, driveways or sidewalks or under existing utilities where such structures are undercut by the excavation, the entire backfill to the subgrade of the structures shall be made in 6-inch lifts with mechanically compacted granular backfill material as specified in Paragraph 2.4 and 2.7.

**** END OF SECTION ****

SECTION 31 23 13 - SUBGRADE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performance of all work and services necessary or incidental to the subgrade preparation as indicated on the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section will be included in the Lump Sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. MnDOT 2112 will apply to this Section.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. No submittals for this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. No exception to the referenced specification is made.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. At the end of each day, and before the placement of aggregate base, the Contractor shall eliminate surface indentations, including those caused by sheeps foot rollers and tractor cleats, and roll the surface with a steel wheel or rubber-tired roller.

B. The Contractor shall disc, scarify, shape and compact the street subgrade or existing base, adding water or drying as may be necessary to give uniform and desired density.

C. If the subgrade is unstable and the instability is due to excessive moisture, the subgrade will be scarified and dried over a reasonable period. When the material has reached acceptable moisture limits, the material will be returned to the roadbed and compacted into place to the proper elevation. The roadbed will once again be test rolled. If the material continues to be unstable, the Engineer may authorize the removal of the undesirable material as subgrade excavation.

D. Once the subgrade has been test rolled and accepted by the Engineer, no traffic or construction equipment will be permitted to operate directly on the subgrade without the prior approval of the Engineer. All equipment will be restricted to operating only in areas where the aggregate base has been installed to its full design depth. If inclement weather occurs after a test roll, and before placement of the aggregate base or first course of bituminous, the test roll will be voided and a new test roll will be performed.

E. The subgrade will be compacted in accordance with the Quality Compaction Method.

3.2 FIELD QUALITY CONTROL

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A. "Blue Top" stakes will be provided by the Contractor at 50 foot intervals to confirm that the subgrade is constructed to the required grades and elevations. Methods other than "Blue Top" staking may be allowed if approved by the Engineer.

B. The compacted subgrade will be test rolled using a fully loaded aggregate truck (tandem) in a pattern approved by the Engineer. The subgrade stability will be considered adequate when the surface shows less than 1.0 inch of yielding or rutting after one pass, or as otherwise approved by the Engineer.

******END OF SECTION******

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SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to the dewatering of trenches as necessary to construct the elements shown on the drawings or as specified herein.

B. This item will be considered exempt from the requirements of Supplementary Condition 13.03.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the Lump Sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. MnDOT 2451 will apply to this Section.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. No submittals for this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. No exception to this section is made.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The Contractor shall furnish and install all necessary discharge piping and obtain all permits, easements, rights-of-way, etc. to convey and discharge the water at a sufficient distance from the project area to eliminate recharge of the groundwater at the project site.

B. Water from dewatering operations will not be discharged where it will pond or cause damage to cropland or personal property due to the presence of standing or flowing water.

C. Unless otherwise provided in the contract documents; the Contractor shall be responsible for obtaining all necessary permits required for dewatering prior to the beginning of dewatering. The Contractor shall provide a plan for the discharge showing the discharge location, energy dissipation, and water quality treatment to the Engineer for approval before beginning discharge. The discharge rate, location, and water quality will meet all local, State, and Federal requirements.

D. Existing and/or proposed sanitary system(s) shall not be used as an outlet for the dewatering operations.

******END OF SECTION******

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SECTION 31 37 00 - RIPRAP

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to construct the riprap and geotextile fabric as indicated on the drawings or as specified herein.

1.2 METHODS OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section will be included in the Lump Sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. The following referenced Specifications will apply to this Section:

1. MnDOT 2511.
2. MnDOT 3601.
3. MnDOT 3733.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. No submittals for this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The material to be used will be the class riprap and fine filter aggregate shown on the plans as specified in MnDOT 3601.

B. The geotextile fabric shall meet the requirements of MnDOT 3733, Type 4, unless otherwise shown on the plans.

C. The Contractor may choose the type of filter material, except as restricted for geotextile filters, unless the type is specified on the plans.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. No exception to the referenced specification is made.

******END OF SECTION******

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SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment and performances of all work and services necessary or incidental to construct the aggregate base course as indicated on the drawings or as specified herein.

1.2 METHODS OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. MnDOT 2211 shall apply to the construction of aggregate base, except as modified herein.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Provide the following test results for each source of aggregate:

1. Two gradation tests
2. One percent crushing test (only if requested by Engineer).
3. One aggregate quality test (only if requested by Engineer).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Only MnDOT 3138-compliant Class 5 Aggregate Base shall be permitted. Recycled or reclaimed materials may be used if they meet all MnDOT 3138 requirements for Class 5 Aggregate Base.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. At the end of each day the Contractor shall eliminate surface indentations, including those caused by sheeps foot rollers and tractor cleats, and roll the surface with a steel wheel or rubber-tired roller.

B. The depth and class of aggregate base to be constructed shall be as shown on the plans. Aggregate base construction shall take place only after the street subgrade condition and grade has been examined by the Engineer.

C. Pneumatic rollers are required for compaction on all aggregate base courses with recycled bituminous unless otherwise approved by the Engineer.

D. All aggregate base courses shall be compacted using the Quality Compaction Method.

E. The compacted aggregate base shall be test rolled using a fully loaded aggregate truck (tandem) in a pattern approved by the Engineer. The stability of the compacted base shall be considered adequate when the surface shows less than 1.0-inch of yielding or rutting after one pass, or as otherwise approved by the Engineer. The test rolling of the compacted aggregate base using a fully loaded aggregate truck (tandem) shall be incidental.

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3.2 SOURCE QUALITY CONTROL

A. The Owner may arrange for having the following testing performed:

1. One gradation test for each 500 tons or 275 cubic yards (CV) of each class of aggregate base.

2. One percent crushing test.

3. One aggregate quality test.

B. Samples for testing shall be taken from material in stock at locations approved by the Engineer. All sampling methods shall be approved by the Engineer.

C. The Contractor shall cooperate fully with the individuals performing the tests.

D. Should any of the specified tests fail, the Contractor may arrange and pay for additional tests as may be necessary to satisfy the Engineer that the requirements have been met.

3.3 FIELD QUALITY CONTROL

A. "Blue Top" stakes shall be provided by the Contractor at 50.0-foot intervals to confirm that the base is constructed to the required grades and elevations. Methods other than "Blue Top" staking may be allowed, if approved by the Engineer.

******END OF SECTION******

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SECTION 32 12 00 - FLEXIBLE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to the construction of plant-mixed bituminous surfacing utilizing the MnDOT Gyratory Design Specification (2360) as indicated on the plans or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCE

A. MnDOT 2360 shall apply, except as modified herein.

B. MnDOT 2357 shall apply, except as modified herein.

C. MnDOT 3139 shall apply, except as modified herein.

D. Unless noted otherwise, the provisions in this Section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Bituminous Mix Design (wear and non-wear).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bituminous Tack Coat:

1. The bituminous material for tack coat will be limited to one of the following kinds of emulsified asphalt. However, the Engineer may authorize the use of medium cure cutback asphalt (MC-250) during the early and late construction season when it is anticipated the air temperature may drop below 32 degrees Fahrenheit. Cutback asphalt shall be used only when approved by the Engineer.

   (a) Emulsified Asphalt

      (1) Anionic SS-1, SS-1h

      (2) Cationic CSS-1, CSS-1h

   (b) Cutback Asphalt:

      (1) Medium Cure Liquid Asphalt MC-250

2. Only Certified Sources are allowed for use. MnDOT's Certified Source List is located at the following link: http://www.dot.state.mn.us/products/index.html .

B. Bituminous material and aggregate shall be as shown on the typical sections in the plans.

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PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Bituminous Tack Coat

1. The tack coat shall not be applied when the road surface or weather conditions are unsuitable as determined by the Engineer.

2. At the time of applying bituminous tack coat material, the road surface shall be dry and clean, and all necessary repairs or reconditioning work shall have been completed as provided for in the Contract and approved by the Engineer.

3. Unless otherwise indicated in the Plans or provisions, the bituminous tack coat material shall be applied within the application rates shown in the table below as based on pavement type or condition and type of bituminous material. The Engineer shall approve the time and rate of application. Only a MnDOT certified asphalt emulsion supplier is allowed to dilute the emulsion. When diluted, the supplier shall provide asphalt emulsion diluted 1-part emulsion to 1-part water. Dilution of asphalt emulsion in the field is not allowed. The Engineer may waive the tack coat requirement when multiple lifts are paved on the same day.

Pavement Type or Condition	**Application Rate - gallons/sy**		
	Undiluted Emulsion SS-1, SS-1H, CSS-1, CSS-1H	**Diluted Emulsion (1 part Emulsion to 1 part water)[1] SS-1, SS-1H, CSS-1, CSS-1H**	**MC Cutback[2] MC-250**
New HMA	0.03 – 0.05	0.06 – 0.10	0.03 – 0.05
Aged HMA[3] or Un-milled PCC	0.05 – 0.08	0.10 – 0.15	0.05 – 0.08
Milled HMA or Milled PCC	0.07 – 0.10	0.14 – 0.20	0.07 – 0.10

[1]As provided by the asphalt emulsion supplier
[2]When approved by the Engineer
[3]Older than 1 year

4. The temperature of the bituminous material at the time of application shall be approved by the Engineer, within the limits specified following:

(a) SS-1, SS-1H, CSS-1, CSS-1H .....70 to 160 Degrees Fahrenheit

(b) MC-250 .....165 to 220 Degrees Fahrenheit

B. The bituminous wearing course shall be constructed in the construction season following the season in which the underground utilities, aggregate base and bituminous base course have been constructed.

C. The Contractor is required to use the self-propelled pneumatic tire roller as an intermediate roller on the wearing courses.

D. Cut the adjacent asphalt surface prior to construction of the bituminous surface course to obtain a clean, vertical, solid edge.

3.2 SOURCE QUALITY CONTROL

A. The bituminous mix shall be designed using Contractor Trial Mix Designs. A current MnDOT mix design may be accepted provided it represents the aggregate source and bituminous plant being used for the project, and is approved by the Engineer. No bituminous mixture shall be placed without an approved mix design.

B. Testing of the material bituminous tack coat may be required, if determined by the Engineer, that the material appears suspect.

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3.3 FIELD QUALITY CONTROL

A. If required by the Engineer, cores for mat density and for lift thickness verification shall be taken, except that for daily production less than 300 tons, the Engineer may require that two cores are taken (one for Contractor testing and one companion core). Sample locations shall be designated by the Engineer and made with a drilling device that produces clean sharp, vertical edges.

B. Lift Thickness Tolerances:

1. If any cores indicate lift thicknesses outside of the specified tolerances, the Contractor may, at its own cost and expense, take additional core samples to further define the extent of the deficiency.

2. The Engineer shall calculate deficient pavement areas using the locations and thickness results of all core samples and prorating the thickness profile.

3. Reduction in payment for bituminous courses constructed to more than the maximum permissible thickness, except that the thickness tolerances specified herein apply.

C. Testing:

1. For projects with 2000 tons or less of a particular mix type, delete Tables 2360.2-7 and 2360.2-8 of the referenced MnDOT 2360 and substitute the following:

Production Test	**Sampling and Testing Rates (each mix type)**	**Test Reference (Laboratory Manual unless otherwise indicated)**	**Spec Section**
Bulk Specific Gravity	Divide the planned production by 500. Round up to the next whole number	1806	2360.2.G.7.b
Maximum Specific Gravity		1807	2360.2.G.7.c
Air Voids (calculated)		1808	2360.2.G.7.d
Asphalt Content		1853	2360.2.G.7.a
Add AC/Total AC Ratio (calculated)		1853	2360.2.G.7.a
Adj. AFT (Calculated)		1854	2360.2.E.7.e
Gradation	1 gradation per 500 tons or portion thereof (at least one per day)	1203	2360.2.G.7.f
Coarse Aggregate Angularity	1 test per 500 tons or portion thereof. If CAA >8 percent of requirement, 1 sample per day but test 1 per week.	1214	2360.2.G.7.g
Fine Aggregate Angularity (FAA)	1 test per 500 tons or portion thereof. If FAA >5 percent of requirement, 1 sample per day but test 1 per week.	1213	2360.2.G.7.h
Fines to Effective Asphalt Ratio (calculated)	Divide the planned production by 500. Round up to the next whole number	1203 & 1853	2360.2.G.7.f & 2360.2.G.7.a
TSR	As directed by the Engineer	1213	2360.G.7.i
Aggregate Specific Gravity	As directed by the Engineer	1204, 1205, and 181	2360.G.7.j

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Production Test	Sampling and Testing Rates (each mix type)	Test Reference (Laboratory Manual unless otherwise indicated)	Spec Section
Mixture Moisture Content	Daily unless otherwise required by the Engineer	1805	2360.G.7.k
Asphalt Binder	As directed by the Engineer]	MnDOT Bituminous Manual 5-693.920	2360.G.7.l

2. Contractor shall send a copy of the testing results to the Engineer.
3. Should any of the specified tests fail, the Contractor shall notify the Engineer immediately and shall arrange and pay for additional test as may be necessary to satisfy the Engineer that the requirements have been met.

******END OF SECTION******

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SECTION 32 15 00 - AGGREGATE SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment and performances of all work and services necessary or incidental to construct the aggregate surfacing / shouldering as indicated on the drawings or as specified herein.

1.2 METHODS OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. MnDOT 2118 shall apply to the construction of aggregate surfacing, except as modified herein.

B. MnDOT 2221 shall apply to the construction of aggregate shouldering, except as modified herein.

C. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Provide the following test results for each source of aggregate:

1. Two gradation tests
2. One percent crushing test (only if requested by Engineer).
3. One aggregate quality test (only if requested by Engineer).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials included here consist of new aggregate surfacing, Class 2. If additional rock is used to provide a coarser Class 2 gradation, the added materials must pass the Los Angeles Rattler (L.A.R.) test.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. At the end of each day the Contractor shall eliminate surface indentations, including those caused by sheeps foot rollers, tractor tires and tracked equipment, and roll the surface with a steel wheel or rubber tired roller.

B. The depth and class of aggregate surfacing to be constructed shall be as shown on the plans. Aggregate surfacing construction shall take place only after the subgrade or aggregate base condition and grade has been examined by the Engineer.

C. Existing aggregate surfacing shall be salvaged prior to commencing trenching activities and shall be restored after underground construction is completed.

D. Compaction of the aggregate surfacing courses shall be by the Quality Compaction Method.

E. The compacted aggregate surface shall be test rolled using a fully loaded tandem axel truck in a pattern approved by the Engineer. The stability of the compacted aggregate shall be considered adequate when

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the surface shows less than one ¾-inch of yielding or rutting after one pass, or as otherwise approved by the Engineer. Test rolling shall be incidental.

3.2 SOURCE QUALITY CONTROL

A. The Owner shall arrange for and pay all costs associated with having the following testing performed:

1. One gradation test for each 500 tons or 275 cubic yards (CV) of each class of aggregate.
2. One percent crushing test (if required by the Engineer).
3. One aggregate quality test (if required by the Engineer).

B. Samples for testing shall be taken from material in stock at locations approved by the Engineer. All sampling methods shall be approved by the Engineer.

C. The Contractor shall cooperate fully with the individuals performing the tests.

******END OF SECTION******

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SECTION 32 16 14 - CURBS, GUTTERS, AND DRIVEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. This work consists of constructing cast-in-place concrete curbs, curb and gutter, medians, driveway pavement, pedestrian ramps, and other similar traffic delineation or service items as indicated on the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. MnDOT 2301.

B. MnDOT 2531.

C. MnDOT 3137.

D. MnDOT Standard Plates.

E. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. A copy of the certified mix design shall be submitted to the Engineer for review at least seven days prior to the placement of any concrete.

B. A MnDOT approved mix design or a mix design prepared by an independent certified testing laboratory secured by the Contractor will be accepted.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Adjust class and composition of coarse aggregate material in the mixture to comply with 3.2.B.

B. The coarse aggregate designation shall be ASTM #67* from MnDOT Table 3137.2-4.

C. High early strength concrete shall be used for all driveway pavement.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The use of dimensional lumber as forms is permitted if the dimension of the lumber is within ½-inch of the specified dimension of the finished concrete.

B. The width of all driveways shall be established in the field by the project Engineer or Owner.

C. The joints in the driveway pavement shall match with the sidewalk and curb control joints. The Contractor shall be fully responsible for proper jointing patterns. Mismatched jointing will require removal and replacement of components in order to achieve the desired results. All removal and replacement of rejected construction shall be at the Contractor's expense.

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D. The tooling tolerances as outlined in MnDOT 2531 for surface uniformity, alignment and jointing shall be reviewed by the Contractor prior to the construction. Defects found during examinations will require the Contractor to remove and replace those areas. No deduction in unit price will be acceptable to satisfy defective areas found.

E. Backfill along exposed edges of slabs and/or behind the curb with selected salvage material from the excavation to the elevation shown on the design detail plate.

F. The Contractor shall imprint the concrete curb at the locations of the utility service locations if indicated and in accordance with the plans.

G. When the pavement is placed directly on natural subgrade, earth check dams shall be constructed immediately after passage of the slip forms or removal of the forms to prevent water from flowing along the edge of the pavement and undermining the concrete. They shall not be spaced or be of a width to provide an approach over which a vehicle may be driven onto the pavement.

3.2 FIELD QUALITY CONTROL

A. Testing

1. The Owner may conduct various material tests throughout the construction to determine conformance with these specifications, including but not limited to:

(a) Air and slump cone tests.

(b) Beam and cylinder testing.

2. The Contractor's shall cooperate with the individuals conducting the testing operations.

B. Surface Requirements

1. Immediately after placement and within the warranty period, no finished surface shall exceed the following defect rates. A surface defect is defined as any loss of aggregate or mortar from the surface that is larger than ¼-inch in diameter and greater than ¼-inch in depth. Any area not meeting the below thresholds shall be considered defective work and replaced at no expense to the Owner.

(a) Defect Thresholds:

(1) Five (5) per 10 LF section of curb and gutter.

(2) Twelve (12) per 10-foot by 10-foot panel of driveway.

2. The following shall also be considered as defective work at any rate and replaced at no expense to the Owner:

(a) Cracking outside of control joints.

(b) Surface flaking / mortar flaking.

(c) Surface spalling.

(d) Surface imprints not conforming to specified texture and finish.

(e) Chipping.

C. Defective sections or panels shall be replaced to the nearest construction joint.

******END OF SECTION******

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SECTION 32 16 23.13 – CONCRETE WALKS

PART 1 - GENERAL

1.1 SUMMARY

A. This work consists of constructing concrete or bituminous walks.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATIONS REFERENCES

A. MnDOT 2521 shall apply to the construction of concrete walks, except as modified herein.

B. MnDOT 3137 shall apply, except as modified herein.

C. MnDOT Standard Plates.

D. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. A copy of the certified mix design shall be submitted to the engineer for review at least seven days prior to the placement of any concrete.

B. A MnDOT approved mix design or a mix design prepared by an independent certified testing laboratory secured by the Contractor will be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. CONCRETE

1. Adjust class and composition of coarse aggregate material in the mixture to comply with 3.2.B.

2. The coarse aggregate designation shall be ASTM #67* from MnDOT Table 3137.2-4.

B. The foundation materials shall be in accordance with the plans.

C. TRUNCATED DOME SYSTEMS FOR PEDESTRIAN CURB RAMPS.

1. The approved products are those listed on the MnDOT web site – No Stainless Steel ramps are allowed. http://www.dot.state.mn.us/products/detectablewarningsurfaces/index.html.

2. Truncated domes shall not be colored.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The use of dimensional lumber as forms is permitted if the dimension of the lumber is within ½-inch of the specified dimension of the finished concrete.

B. When the pavement is placed directly on natural subgrade, earth check dams shall be constructed immediately after passage of the slip forms or removal of the forms to prevent water from flowing along the edge of the pavement and undermining the concrete. They shall not be constructed to provide an approach over which a vehicle may be driven onto the pavement.

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3.2 FIELD QUALITY CONTROL

A. Testing

1. The Owner may conduct various material tests throughout the construction to determine conformance with these specifications, including but not limited to:

(a) Air and slump cone tests.

(b) Beam and cylinder testing.

2. The Contractor's shall cooperate with the individuals conducting the testing operations.

B. Surface Requirements

1. Immediately after placement and within the warranty period, no finished surface shall exceed the following defect rates. A surface defect is defined as any loss of aggregate or mortar from the surface that is larger than ¼-inch in diameter and greater than ¼-inch in depth. Any area not meeting the below thresholds shall be considered defective work and replaced at no expense to the Owner.

(a) Defect Thresholds: Four (4) per 5-foot by 5-foot panel of walk.

2. The following shall also be considered as defective work at any rate and replaced at no expense to the Owner:

(a) Cracking outside of control joints.

(b) Surface flaking / mortar flaking.

(c) Surface spalling.

(d) Surface imprints not conforming to specified texture and finish.

(e) Chipping.

C. Defective sections or panels shall be replaced to the nearest construction joint.

******END OF SECTION******

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SECTION 32 91 19.13 - TOPSOIL PLACEMENT AND GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. All labor, materials, equipment, and supervision required to furnish and install amended soil and topsoil to finished grade, as shown on the Plan Sheets.

1.2 MEASUREMENT AND PAYMENT

A. Measurement and compensation for the following items shall be paid according to the referenced specification or as modified below:

1. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

2. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCE

A. MnDOT 3877 Topsoil Materials

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. No submittals for this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Unless otherwise specified on the plans, topsoil types shall be provided as follows:

1. Common Topsoil Borrow shall be used for areas to be seeded or sodded.

PART 3 - EXECUTION

3.1 TOPSOIL PLACEMENT AND FINISH GRADING FOR SEEDING

A. Topsoil should be placed to a 6.0-inch finished depth in all areas to be seedded.

B. Prepare soil for planting so that only light raking, or scarifying will be required.

C. Round finished surfaces at abrupt changes in slope.

D. Should spot elevations for finished grades conflict with finished contours, the spot elevations shall govern.

E. Finished grades to uniform levels or slopes between points where levels are given or between such points and existing grades.

F. Positively drain all areas to designated surface water collection points, streets, and/or waterways.

G. Protect paving, sidewalks, utilities, and plants during finish grading; repair or replace any items damaged by construction operations at no cost to Owner. Equipment that may leave black tire marks should not be driven on sidewalk or paver areas, or marks must be removed, without damage to walks or pavers, prior to project acceptance.

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H. After placement, maintain surfaces to indicated finished grades; deposit additional topsoil or amended soil to repair settlement or erosion up to the date of final acceptance. Scarify surfaces upon which additional topsoil is to be deposited.

3.2 MAINTENANCE

A. Protection of graded areas:

1. Protect newly graded areas from traffic and erosion.

2. Keep free of trash and debris.

3. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

4. Keep public streets clean from soil, soil tracking, and debris at all times.

B. Reconditioning Compacted Areas: Where completed graded areas are disturbed by subsequent construction operations, erosion or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction at no cost to the Owner.

C. Settling: Where settling is measurable or observable during general project warranty period, add topsoil or amended soil, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work and eliminate evidence of restoration at no cost to the Owner.

3.3 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Remove waste materials, including unacceptable excavated material, trash, and debris from the job site.

3.4 PROTECTION OF SIDEWALK

A. Equipment that may leave black tire marks shall not be driven on sidewalk or special paver areas, or marks must be removed without damage to walks prior to acceptance.

******END OF SECTION******

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SECTION 32 92 00 – TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment and performances of all work and services necessary or incidental to turf restoration as indicated on the drawings or as specified herein.

B. A variety of different seeding mixtures may be utilized on this project. The Contractor shall refer to the plan for the locations of the different turf establishment areas.

C. Temporary seeding may be necessary during construction in erosion sensitive areas. The Contractor shall do temporary seeding work as specified herein or as directed by the Engineer.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. The following referenced Specifications will apply to this Section:

1. MnDOT 2574.
2. MnDOT 2575.
3. MnDOT 3876.
4. MnDOT 3877.
5. MnDOT 3878.
6. MnDOT 3881.
7. MnDOT 3882.
8. MnDOT 3884.
9. MnDOT 3885.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Seeding - Certificates of Compliance for seed mixture.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seeding

1. The seed mixtures to be used are shown on the plans.
2. Unless otherwise specified on the plans, all application rates for MnDOT mixes, except temporary seed, are 150 percent the specified rate.
3. Type 1 mulch shall consist of clean straw with no pasture hay.
4. All seed shall be supplied as pure-live seed (PLS).

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5. All seed and seed mixes shall conform to State seed requirements for noxious weed content.
6. All seed and seed mixes shall conform to State labeling requirements. For all species in the mix, the label and or invoice shall include the county of origin, and if from Canada, the province.

B. Imported Topsoil

1. Unless otherwise indicated on the plans, imported topsoil borrow for general use as a turf growing medium shall comply with MnDOT 3877.2.A.
2. Unless otherwise indicated on the plans, imported topsoil borrow for use as a plant growing medium in designated areas such as landscape beds shall meet the requirements of MnDOT 3877.2.B.

C. Fertilizer

1. Fertilizer shall be In accordance with MnDOT.
2. Fertilizer shall be applied at a rate in accordance with MnDOT.

D. Hydraulic Matrix

1. Hydraulic Matrix shall be MnDOT Type Bonded Fiber Matrix
2. Hydraulic Matrix shall be applied at a rate of 3500 lbs/acre (dry weight)

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. GENERAL

1. The subgrade shall be shaped to the approximate contour of the finished surface. All construction debris shall be removed from the area prior to the placement of the topsoil. The subgrade shall be loosened with a disc or harrow to a depth of 6.0-inches prior to application of the topsoil.
2. The topsoil shall be shaped to the approximate contour of the finished surface, with a minimum depth of 6.0-inches, unless otherwise shown on the plan. All construction debris, rocks and trash shall be removed from the area prior to seeding or sodding. The topsoil shall be loosened with a disc or harrow to its full depth prior to seeding or sodding.
3. The Contractor shall be responsible for providing water and maintenance for a period of 30 calendar days, or until final acceptance by the Owner, to firmly establish the seed or sod. The term maintenance includes mowing, weed control and watering, as necessary. Failure to perform this work within 24-hours of notification of non-compliance may result in the Owner or Engineer arranging for completion of the work by others. A contract deduction will be made equal to the total of all costs to perform such work so arranged, including but not limited to, labor, materials, equipment and administrative costs.
4. Where dormant seeding or sodding is authorized, the maintenance period will be extended to include the first 30 calendar days after the beginning of the growing season. The beginning of growing season will be defined as bud burst.

B. SEEDING REQUIREMENTS

1. Turf establishment by seeding shall be done utilizing the various combinations of seed mixtures (including aquatic plants), fertilizing and mulching at disturbed areas as shown on the plans.
2. Areas prepared for seeding shall be free of rocks, debris and clumps of soil. The areas shall be graded uniformly, and vegetated areas shall be raked free of chunks exceeding ½-inch diameter.
3. Seed shall be applied with a drill seeder, unless otherwise approved by the Owner.

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4. The Contractor shall furnish weight tickets documenting pounds of hydraulic soil stabilizer placed, pounds of fertilizer placed, and pounds of seed placed. The seed tickets shall show individual plant species along with the percent purity and percent germination. The fertilizer tickets shall show mix proportions. The Contractor shall also furnish its QA/QC data to the Engineer.
5. Dormant seeding and snow seeding may be utilized in accordance with the referenced specification and technical memorandum, provided the final acceptance standards are met.
6. Final acceptance of seeding will be based on an established growth of 6.0-inches with a uniform density to cover 70 percent of the designated area, free of weeds and bare spots. Any re-seeding necessary shall be performed at the Contractor's expense.

******END OF SECTION******

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SECTION 33 01 30.12 - CLEANING AND TELEVISION INSPECTION OF SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sanitary sewer cleaning, televising and inspection of pipe, fittings, and miscellaneous appurtenances.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. No references for this section.

1.4 SUBMITTALS

A. A minimum 5 working days prior to mobilization:

1. A sanitary sewer bypass pumping plan

(a) Shall be submitted to the Engineer for review a minimum 5 working days prior to beginning of work.

(b) The bypass pump system will be of sufficient capacity to handle existing flow at peak flow times.

2. Traffic Control and Work Zone Signage Plan

(a) Shall be submitted to the Engineer for review a minimum 5 working days prior to beginning of work.

B. File Naming

1. The Contractor will be provided with a map showing manhole and pipe identification numbers.

2. All files shall be named using the upstream and downstream structure numbers.

C. Televising Video.

D. A summary report which includes a table showing the following information:

1. Owner’s upstream and downstream structure numbers.

2. Date of televising.

3. Starting manhole number.

4. Ending manhole number.

5. File names for video, report, and images associated with each section of pipe.

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PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOTIFICATIONS TO PROPERTY OWNERS

A. The Contractor shall coordinate and distribute any required public notices.

3.2 SANITARY SEWER CLEANING

A. Cleaning Equipment

1. Hydraulically propelled equipment.

(a) Equipment will be of a movable dam type and be constructed in such a way that a portion of the dam may be collapse at any time during the cleaning operations to protect against flooding of the sewer.

(b) The movable dam will be equal in diameter to the pipe being cleaned and will provide a flexible scraper around the outer periphery to insure removal of grease.

(c) If sewer cleaning balls or other equipment which cannot be collapsed is used, special precautions to prevent flooding of the sewers and public or private property will be taken.

2. High-Velocity Jet (Hydro cleaning) Equipment.

(a) All high-velocity sewer cleaning equipment will be constructed for ease and safety of operation.

(b) The equipment will have a selection of 2 or more high-velocity nozzles.

(c) The nozzles will be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned.

(d) Equipment will include a high-velocity gun for washing and scouring manhole walls and floor.

(e) The gun will be capable of producing flows from a fin spray to a solid stream.

(f) The equipment will carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel.

3. Mechanically Powered Equipment.

(a) Bucket machines will be in pairs with sufficient power to perform the work in an efficient manner.

(b) Machines will be belt operated or have an overload device.

(c) Machines with direct drive that could cause damage to the pipe are not permitted.

(d) A power rodding machine will be either a sectional or continuous rod type capable of holding a minimum of 750.0-feet of rod.

(e) The rod will be specifically heat-treated steel.

(f) The machine will be fully enclosed and have an automatic safety clutch or relief valve.

B. Cleaning Precautions

1. During sewer cleaning operations, satisfactory precautions will be taken in the use of cleaning equipment.

2. When hydraulically propelled cleaning tools or tools which retard the flow in the sewer lines are used, precautions will be taken to ensure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. Contractor will be fully responsible for any property damage caused by the cleaning operations.

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3. When possible, the flow of sewage will be utilized to provide the necessary pressure for hydraulic cleaning devised.

4. When additional water from fire hydrants is necessary to avoid a delay in normal work procedures, the water will be conserved and not used unnecessarily. Contractor must coordinate with Spring Valley Public Utilities.

5. No fire hydrant will be obstructed in case of a fire in the area served by the hydrant.

C. Sewer Cleaning

1. The cleaning of the sewer lines will begin upstream and work downstream.

2. The sewer manhole sections will be cleaned using hydraulically propelled, high-velocity jet or mechanically powered equipment. Selection of the equipment will be based on the conditions of lines at the time the work commences.

3. The equipment will be capable of removing dirt, grease, rocks, sand and other materials and obstructions from the sewer lines and manholes.

4. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment will be set up on the other manhole and cleaning will be attempted again.

5. If successful cleaning from both manholes cannot be completed, Contractor will contact the Engineer.

D. Root Removal

1. Roots will be removed completely where root intrusion is a problem.

2. Any roots which could inhibit the proposed construction will be removed.

E. Material Removal

1. All sludge, dirt, sand, rocks, grease and other solids or semisolid material resulting from cleaning operations will be removed at the downstream manhole of the section being cleaned.

2. Passing material from manhole section to manhole section, which could cause line stoppages, accumulation of sand in wet wells, or damage to pumping equipment, will not be permitted.

F. Disposal of Material

1. All solids or semisolids resulting from the cleaning operations will be removed from the site and disposed of at a site secured by Contractor.

2. All materials will be removed from the site no less often than at the end of each workday. Under no circumstances will Contractor be allowed to accumulate debris on the site of work.

G. Final Acceptance

1. Acceptance of sewer line cleaning will be made up on successful completion of the television inspection and will be to the satisfaction of the Owner.

2. If television inspection shows the cleaning to be unsatisfactory, Contractor will be required to re-clean and re-televise the sewer line until cleaning is shown to be satisfactory.

3.3 EXAMINATION

A. Commence televising only when pipe and structures are clean and free of dirt or other foreign matter.

3.4 SEWER FLOW CONTROL

A. When sewer line depth of flow at the upstream manhole of the manhole section being worked in is above the maximum allowable for television inspection, the flow will be reduced to the level shown below by operation of pump stations, plugging or blocking of the flow or by pumping and bypassing of the flow as specified.

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B. Plugging or Blocking

1. Perform bypass pumping as need to complete the work.
2. A sewer line plug will be inserted into the line upstream of the section being worked.
3. The plug will be designed so that all or any portion of the sewage can be released in accordance with the Engineer.
4. During television inspection, flow will be reduced within the limits specified above.
5. After the work has been completed, flow will be restored to normal.

C. Pumping and Bypassing

1. When Pumping and bypassing is required, Contractor will supply the pumps, conduits and other equipment to divert the flow of sewage around the manhole section in which work is being performed.
2. Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypass pumping system. If pumping is required on a 24-hour basis, engines will be equipped in a manor to keep noise to a minimum.

D. Flow Control Precautions

1. When flow in a sewer line is plugged, blocked or bypasses, sufficient precautions must be taken to protect the sewer lines from damage that might result from surcharging.
2. Precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property be served by the sewers involved.

3.5 SANITARY SEWER TELEVISING

A. General

1. Televising will be performed on all gravity/pressure utility lines that are shown in the plans and specifications.
2. Camera – The camera will be a self-propelled unit providing color video with the ability to tilt up and down and pan left to right. The camera lens will be capable of turning and looking up each wye or service tap to a minimum distance of the first fitting of the service pipe. The camera is to provide color video and still photographs of any defect.
3. Rate – The televising will be conducted at a rate not to exceed 30.0-feet per minute.

B. Line Requirements

1. All lines will be jetted and vacuumed so that all debris has been removed prior to televising.
2. A small quantity of water is to be introduced into the line prior to televising. Amount will be determined by the Engineer and coordinated with the Owner's Water and Sewer Department. The amount of water will be sufficient enough to distinguish any sags or alignment problems with the pipe.
3. Each run will consist of a starting and ending MH-#, pipe material and diameter, direction of flow, and a zero reading on the counter at center of the starting manhole.
4. Each service wye will be examined using the pan and tilt feature.
5. The video camera operator will type into the video the station (distance), wye location on either the top, left, or right side of the pipe and any problems they notice while televising the sewer lines. Examples of defects include offset joints, leaking joints, sages, cracked pipe, etc.

C. Manhole Requirements

1. Examine upstream and down doghouses for water tightness.

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2. Examine all joints to confirm watertight quality of gaskets and seals.
3. While at the bottom of the manhole, the camera will examine for infiltration as high as it can see around the entire manhole circumference.
4. Examine vertical drops.

D. Report Requirements

1. A technician will observe the monitor at all times during the televising and record the data per NASSCO standards.
2. Date, time, city, street, name of operator, inspector, and weather conditions.
3. Note locations, length, and depth of any sag in the pipe (indicate any depths greater than ½-inch).
4. Note locations, length, and depth of any areas of dirt or debris in the pipe (indicate any depths greater than ½-inch).
5. Note all defective or substandard areas identified during the inspection.
6. Record distance from center of manhole to center of manhole.
7. Note each change in pipe material, including station.
8. Note each wye or service tap location with station and orientation (Example: wye right, 3 o'clock).
9. Note direction of flow using cardinal/ordinal directions.
10. Include color photos/images of defects in the written report.

E. Review

1. All television reports and videos will be reviewed after the submittal is received.

F. Video and Reporting Format

1. All televising videos and reports shall be uploaded to a USB flash drive.
2. Video files shall be viewable without the use of specialty software.
3. Report files shall be in .pdf format, viewable using standard Adobe or Bluebeam software.
4. File Naming
   (a) The Contractor will be provided with a map or plan showing manhole identification numbers.
   (b) All files shall be named using the upstream and downstream structure numbers.

******END OF SECTION******

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SECTION 33 01 30.23 - PIPE BURSTING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment and performances of all work and services necessary or incidental to splitting or fracturing an existing pipe (sanitary sewer, stormsewer, culvert, watermain, forcemain, etc.) and the simultaneous installation of a high density polyethylene (HDPE) pipe which is pulled into the position of the original conduit by use of a cable winch. Other methods, rather than winch, will be considered, providing they meet the other provisions of this specification.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Measurement and compensation for the following items will be paid according to the referenced specification or as modified below:

1. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The furnishing and installing of specific items and/or the performance of work under certain circumstances shall not be individually paid in the absence of a specific bid item for the work. All costs shall be included in the lump sum bid. Such items of work include but are not limited to:

1. Interference of other underground structures and utilities

(a) The removal and restoration, or protection of existing utilities that are shown on the plans and for which there is no bid item for removing and restoring, or working around the utility.

2. Unless separately itemized in the Schedule of Unit Prices, any dewatering necessary for storm sewer construction.

3. Foundation materials placed in lieu of performing necessary dewatering.

4. Locating and connecting to an existing intersecting pipes.

5. The costs of furnishing bends, adapters, cutting and removing the existing pipe.

6. Locating and connecting to an existing service laterals.

7. Foundation, bedding and encasement materials.

8. Maintenance of an appropriate storm water outlet during construction.

9. The replacement of all material displaced due to shrinkage or loss during the excavation and backfilling operations.

10. Compaction and deflection testing

11. Delays due to other utility conflicts that result during the course of construction.

12. Protecting existing improvements from damage.

13. Protecting the inverts of other utility pipes from the accumulation of debris and soil, the removal of blockages which threaten to damage property, and/or the cleaning of both the newly constructed lines and the existing lines of all debris and soil which accumulated during the construction.

14. The removal and discarding of defective materials and joints from the job site.

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1.3 SPECIFICATION REFERENCES

A. The following referenced Specifications will apply to this Section:

1. ASTM F714.

2. ASTM D1248.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Items to be Included with the Bid.

1. The diameter, wall thickness and type of material to be used. Pipe strength determination will include calculations based on new material properties and long-term properties.

2. The types and model numbers of the bursting equipment to be used.

3. The manufacturer's certificates of compliance with provisions of the referenced standards and these specifications.

4. A copy of the license or certificate verifying the bursting equipment manufacturer's or licensor's approval of the Installer.

5. Evidence of the Installer’s experience including a list of similar projects completed within the previous 2 years.

B. DVD’s

1. All DVD’s and construction logs, or copies thereof, will become the property of the Owner. This includes the DVD’s taken at the beginning of the project just prior to the bursting.

2. Two copies of all DVD’s will be submitted. One to the Owner and one to the Engineer.

3. Bypass plan for transferring flow from upstream of the area to be replaced to downstream.

PART 2 - PRODUCTS

2.1 QUALIFICATION

A. Qualification process

1. Installers wishing to qualify alternate methods and/or materials for this project must submit a copy of the license or certificate verifying the manufacturer's or licensor's approval, and evidence of the INSTALLER's experience including the number, total length, and locations of bursting projects installed to date using the proposed materials and methods together with the names and phone numbers of facility owners to the Engineer 10 days prior to the opening of bids to allow time for evaluation.

2. The final decision to accept or reject the applicant lies solely with the Engineer and Owner.

2.2 PIPE MATERIAL & STRUCTURAL REQUIREMENTS

A. The pipe material will conform to the minimum structural standards of ASTM D3350 with cell classification 345434C as manufactured under the trade name Opticore (Driscopipe 1200), or equal.

B. The standard dimension ratio (SDR) will be 17, unless otherwise specified in the Schedule of Unit Prices.

C. Replacement Pipe Dimensions: The minimum length will be that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective structures unless otherwise specified. The Contractor will verify the lengths in the field before fabrication.

D. All pipe will be made from virgin material. No rework except that obtained from the manufacturer’s own production of the same formulation will be used.

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E. The pipe will be homogenous throughout and will be free of visible cracks, holes, foreign material, blisters, and/or other deleterious faults.

F. Dimension ratio will be as specified in the Plans.

G. The internal material color will be a light and reflective to facilitate better viewing with televising equipment.

H. Any section of pipe with a gash, blister, abrasion, nick scar, or other deleterious fault greater than 10 percent of the wall thickness, will not be used and must be removed from the site. However, a defective portion of pipe, as defined above, may be cut out and butt-fused in accordance with the procedures herein.

I. Any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing and/or handling will not be used and will be removed from site.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS:

A. PRE-TELEVISING

1. The Contractor will perform its own pre-fabrication televised investigation of the main line prior to initiating the fusing process to determine the precise location of active service locations and the presence of any obstructions or conditions which would impede the process to be performed.

2. Televising will be performed by experienced personnel trained in locating breaks, obstacles, and service connections by close circuit television. The interior of the pipe will be carefully inspected to determine the location of any conditions which may prevent proper bursting and subsequent installation of replacement pipe, and it will be noted so that these conditions can be corrected. A DVD and suitable log will be kept for later reference by the Owner. Each individual reach of pipe will be identified as a 'chapter' on the DVD.

B. NOTIFICATION

1. Notice required. At least seven days before the start of lining, the Contractor will provide notice to those affected by the construction, including the approximate schedule as described below.

(a) Written notice must be given to the adult residents of buildings, and to the owner or administrator of any property directly served by the sewer to be replaced.

(b) The notice must be mailed, or hand delivered to the owner or administrator of a child care building, school building, commercial business, and/or industry.

(c) The notice may be put on or under the door of each residence, one notice for each single-family building and one notice for each unit of a multi-unit building.

(d) At the Contractor's request, the Owner will deliver the notices based on information provided by the Contractor.

2. Contents of notice to residents, administrator, and Owner. The notice required above will specify the days and the hours during which sewer service will be restricted.

3. Reminder Notice: A written, or verbal remainder notice will be delivered by 3:00 pm the day before the actual work.

C. BYPASSING FLOWS

1. The Contractor, when required, will provide for continued flow around the section or sections of pipe designated for repair. The pump and bypass lines will be of adequate capacity and size to handle the flow.

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2. The Contractor will be responsible for continued service to each facility connected to the section of pipe during the replacement process.

3. If backup(s) occur, the Contractor will be responsible for all clean-up, repair, property damage, and claims.

D. FUSING/FABRICATION

1. Polyethylene Pipe

(a) The pipe will be assembled and joined at the site using the butt-fusion method to provide a leak proof joint prior to insertion. All equipment and procedures used will be in strict compliance with the manufacturer's recommendations and specifications.

(b) Threaded or solvent welded joints or connections are not permitted.

(c) Fusing will be performed by personnel certified as fusion technicians by the manufacturer of the polyethylene pipe and/or the fusing equipment.

(d) The butt-fused joints will maintain true alignment and will have uniform roll-back beads from the fusing process. The joint will be watertight and will have a tensile strength equal to that of the pipe.

(e) Adequate cooling time will be allowed prior to the release of the pressure from the fusing unit.

(f) All joints will be subject to acceptance by the Engineer prior to insertion.

(g) All defective joints will be cut out and replaced.

E. BURSTING

1. Splitting or fracturing the existing pipe will be accomplished by a pneumatic burster, a slitting burster, or other styles approved by the Engineer with either front or rear expanders for proper connection to the replacement pipe. The burster will force its way through the existing pipe by fragmenting the existing pipe and compressing the fragments back into the surrounding soil. The burster will be designed to create a void in the surrounding soil through which the replacement pipe may be threaded.

2. The size of the bursting tool will be in accordance with the manufacturer's specifications to achieve the upsizing indicated on the plans, or in the Schedule of Unit Prices, and will be equipped with a shield/expander to prevent collapse of the hole ahead of the replacement pipe insertion.

3. Upon commencement, pipe insertion will be continuous and without interruption from one structure or junction to another, except as approved by the Engineer.

F. INSERTION

1. Insertion or launching pits will only be allowed at locations of existing or proposed structures, unless otherwise approved by the Engineer.

2. In so far as possible, the equipment used will be located in such a way as to minimize the noise impact on surrounding properties. The equipment shall be housed in a silent engine compartment to reduce external noise.

3. The Contractor shall install all necessary pulleys, rollers, bumpers, alignment control devices and other equipment necessary to protect the pipe from damage during insertion. Lubrication, as recommended by the manufacturer, may be used during installation

4. The winch line will be centered in the pipe to be burst with an adjustable boom. The Contractor will determine the slope of the line and if necessary, adjust the position to increase the slope, as directed by the Engineer.

5. The manufacturer's recommended cooling/relaxation time, but not less than 4 hours, will pass after insertion is complete and before any reconnection of service connections, sealing of the annular space,

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and/or the backfilling of the insertion pit. A sufficient excess of new pipe, but not less than 4.0-inches will protrude into the terminating structures.

6. The annular space at each structure will be sealed with a material recommended by the manufacturer for a minimum of 8.0-inches to form a smooth, uniform, watertight joint.

7. Under no circumstance will the pipe be stressed beyond its elastic limit.

G. SERVICE RECONNECTION

1. Upon completion of the insertion of the new pipe and the appropriate allowance for cooling/relaxation, the Contractor will expedite the reconnection of individual services so as to minimize any inconvenience to the neighboring properties.

2. Services will be connected to the replacement pipe by means and materials compatible with the pipe material.

H. POST TELEVISING

1. After completion of the project, including installation of the service connections, the Contractor will perform a televised inspection of the pipe. The DVD will include a voice description, as appropriate, with stationing of services and intermediate structures. Each individual reach of pipe will be identified as a 'chapter' on the DVD.

2. A written report will also be included with the DVD.

******END OF SECTION******

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SECTION 33 01 30.72 - CURED-IN-PLACE PIPE LINING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to the installation of a resin-impregnated flexible liner that is inserted into the original conduit by use of a hydrostatic head. Methods that are pulled in and inflated rather than inverted will be considered, providing they meet the other provisions of this specification. When cured, the finished pipe (CIPP) will be continuous and tight-fitting.

B. Televising of the project site shall be performed by the Contractor.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Measurement and compensation for the following items will be paid according to the referenced specification or as modified below:

1. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The furnishing and installing of specific items and/or the performance of work under certain circumstances will not be individually paid in the absence of a specific bid item for the work. The costs will be included in the unit price bid for the CIPP, as indicated. Such items of work include, but are not limited to:

1. Coordination with City for access to the sanitary sewer systems.
2. Securing and withdrawing from a water source.
   (a) Water can be sourced from hydrants near the project site. When securing water from a Hydrant, the contractor shall use a back-flow preventor and a city supplied meter. There will be no charge for water use on this project.
3. Furnishing, installing, and maintaining traffic control devices where necessary, not already provided for by bid items.
4. Pre-installation and post-installation cleaning and televising.
5. Removal and disposal of internal debris from the sewer mainline and services before installation.
6. Furnishing Robotic Cutters and other specialty equipment needed to trim and remove protruding taps.
7. Providing all required notifications of restricted sewer service periods to the Owner and residents affected by the work as well as coordination of resident relocations and reimbursements, if applicable.
8. Installation of pipe pre-liners or grouting if required to install CIPP in areas of excess infiltration
9. Dye testing as required to determine active laterals (where needed).
10. Installation of hydrophilic end seals at the ends of the liner in each manhole.
11. Removal of liner in manholes if pulling/inverting through manholes (unless manhole is being abandoned).
12. Excavation and restoration are required to reinstate sewer services if the Contractor is unable to reinstate services via trenchless methods.
13. Holding brief meeting with property owners to determine appropriate time to schedule work and expected impact of the properties.
14. General project-related restoration where not already provided by bid items.

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15. Permits:

    (a) Railroad – required by the contractor, traffic control will be within the ROW

    (b) State, City, and County ROW Permits needed to facilitate work.

1.3 SPECIFICATION REFERENCES

A. This specification references below are made a part hereof by such reference and will be the latest edition and revision thereof. In case of conflicting requirements between this specification and the ASTM referenced sections, this specification will govern.

B. The following referenced Specifications will apply to this Section:

1. ASTM F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastics (GRP) Cured-In-Place Pipe (CIPP) will apply, except as modified herein.

2. ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube will apply, except as modified herein.

3. ASTM F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and inflate and Curing of a Resin-Impregnated Tube.

4. ASTM F2561 – Standard Practice for Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One-Piece Main and Lateral Cured-in-Place Liner.

5. ASTM D543 Test Method for Resistance of Plastics to Chemical Reagents

6. ASTM D578 Standard Specification Glass Fiber Strands

7. ASTM D638 Standard Test Method for Tensile Properties of Plastics.

8. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials will apply, except as modified herein.

9. ASTM D2122 Standard 1 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

10. ASTM D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics will apply, except as modified herein.

11. ASTM D3567 Standard Practice for Determining Dimensions of ‘‘Fiberglass’’ (Glass-Fiber Reinforced Thermosetting Resin) Pipe and Fittings

12. ASTM D5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe will apply, except as modified herein.

C. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Prior to installation or use of any material or equipment:

1. Certified test results from the manufacturers indicate that all materials conform to the applicable requirements.

2. Copy of the license or certificate verifying the manufacturer's or licensor's approval of the Installer.

3. Evidence of the Installer’s experience including a list of similar projects completed within the previous 2 years.

4. Proposed construction schedule.

5. A sanitary sewer bypass pumping plan

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(a) Will be submitted to the Engineer for review a minimum of 5 working days prior to the beginning of work.

(b) The bypass pump system will be of sufficient capacity to handle existing flow at peak flow times.

(c) The anticipated flow on this project is to be determined in the field.

(d) The bypass plans shall conform to the following:

(1) When bypassing flows require the crossing county roads or rail roads:

1. No pipe will cross on top of county/state roads or railroads.

2. The referenced bypass plans show a system of storm sewer pipes and structures that can be used to route lay-flat pipe through.

3. When routing lay-flat pipe through the storm system isn't reasonable, a vac-truck operation or equivalent, where the flow is stored on vehicles with containers, shall be used to bypass flow.

(2) When bypassing flows follow the alignment of the sewer system:

1. Standard bypass procedures can be used provided they are contained within the traffic control signs required for installing the CIPP liner.

6. Traffic Control and Work Zone Signage Plan:

(a) Will be submitted to the Engineer for review a minimum of 5 working days prior to the beginning of work.

7. Details of how existing tees, wyes, air relief valves, blow-off valves, threaded taps, etc., will be reinstated. Reinstatements should provide a sufficient seal to prevent water tracking between the pipe lining and the host pipe.

8. Test results of the resin proposed that meet the chemical resistance requirements of ASTM F2019, Section 5.2.6. Tests will be completed in accordance with Test Method D543.

9. The field sampling procedure will be in accordance with ASTM 2019 and accordance with ASTM D5813.

10. Material Safety Data Sheets for all resins, and other additives such as accelerants, colorants, and lubricants utilized in the pipe liner/lining process.

11. Manufacturer information that describes the materials, curing speeds/schedule, curing installation processes, installation pressures, temperature limitations, and recommended post-curing documentation.

12. Residential Informational Handout that describes the materials, processes, installation, pressures, temperature limitations, and odors associated with the lining process that will be provided at the request of concerned residents.

13. Liner pipe thickness design for each pipe segment.

(a) No liner will be approved for installation until liner thickness calculations have been submitted and reviewed for conformance with the specification.

14. Description of cure method(s) proposed by the Contractor.

15. Insignia End Seal Submittal.

B. Prior to final payment:

(a) Televising and construction logs.

(1) These will become the property of the Owner. This includes the videos made at the beginning of the project just prior to the installation of the liner.

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PART 2 - PRODUCTS

2.1 PREQUALIFICATION

A. Only bids for pre-qualified products will be accepted. Bids submitted for products or from Contractors that have not been pre-qualified may be rejected, pending review by the Owner. The Contractor and the proposed method of reconstruction and the product manufacturer's name will be identified on the bid.

B. Pre-qualified Products and Installers

1. Insituform Technologies USA, LLC.

   1140 Bunker Lake Boulevard NW, Anoka, MN 55303, Telephone: 651-762-1238

2. (National Liner) Visu-Sewer

   3155 104th NE Lane, Blaine, MN 55449, Telephone: 763-252-0004

3. Veit Companies

   14000 Veit Place Rogers MN 55374, Telephone 763-428-2242

4. Granite Construction

   2950 Metro Drive # 200, Bloomington, MN 55425, Telephone 952-853-1252

5. Michels Pipe Service – A Division of Michaels Corporation

   817 West Main Street, P.O. Box 128, Brownsville, WI 53006, Telephone: 920-583-3132

6. Sak Construction

   864 Hoff Road, O'Fallon, MO 63366, Telephone 626-385-1000

7. Hydro-Klean

   333 NM 49th Place, Des Moines, IA 50313, Telephone 855-845-5326

8. SJ Louis Construction

   1351 Broadway St W, Rockville, MN 56369, Telephone 320-253-9291

C. Qualification Process

1. Contractors wishing to qualify for this project must submit a copy of the license or certificate verifying the manufacturer's or licensor's approval, and evidence of the INSTALLER's experience including the number, total length, and locations of inversions installed to date using the proposed materials and methods together with the names and phone numbers of facility owners to the Engineer 5 days prior to the opening of bids to allow time for evaluation. The Contractor must have at least five (5) years of active experience installing the CIPP product.

2. The final decision to accept or reject the applicant lies solely with the Engineer and Owner. All decisions will be based upon the long-term best interest of the City.

2.2 MATERIALS

A. Liner - The liner material will meet the requirements of ASTM F1216 and/or ASTMF2019.

B. Resin - The resin system will meet the requirements of ASTM F1216 and/or ASTMF2019. Neat resin will be used for all lining of PVC pipes.

C. Hydrophilic End Seals will be LMK Insignia End Seal or Engineer approved Equal.

2.3 STRUCTURAL REQUIREMENTS

A. The CIPP will be designed as per ASTM F1216, Appendix X1. The CIPP design will assume no bonding to the original pipe wall but a tight, intimate contact is required.

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B. The CIPP will be designed using a Long-Term Creep Retention Factor of fifty percent of the initial design flexural modulus as determined by the ASTM D790 test method. This value will be used unless the Contractor submits long-term test data (ASTM D2990) to substantiate a higher retention factor.

C. The layers of the cured CIPP will be uniformly bonded. It will not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers.

D. If separation of the layers occurs during the testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

E. The CIPP will conform to the following properties:

	Standard	**Min Value**	**UV Value**
Flexural Strength	ASTM - D790	4,500 psi	6,500 psi
Modulus of Elasticity	ASTM - D790	400,000 psi	725,000 psi

F. The design parameters for the 18" CIPP Liners are:

Pipe diameter	18	Inches
Maximum depth from finished ground to invert	See Plans	Feet
Minimum depth from finished ground to invert	See Plans	Feet
Groundwater Depth	See Borings	Feet
Cover density (assumed)	120	Lbs/cf
Design Safety Factor (1.5 for pipes 36 inches and larger)	2.0	Value
Ovality	4%	Percent
Enhancement Factor (K)	7.0	Value
Poisson's Ratio	0.3	Value
Level of Deterioration	Fully Det	Value
Creep Retention Factor	50%	Value
Soil Modulus	1,000- Depth: =/< 15' 1,500- Depth > 15'	psi
Host Pipe Loading	H20 Highway	Value

G. The required structural CIPP wall thickness will be based as a minimum, on the physical properties listed above and in accordance with the Design Equations in the appendix of ASTM F1216. The finished/cured liner thickness will exceed the minimum thickness requirements set forth by the equations in the appendix of ASTM F1216.

H. The contractor shall install a 12.0 mm Nominal/ 10.2 mm Cured/Finished thickness liner minimum on all 18" installations. The contractor should design each segment and submit thicker installation exceeding the minimum as required by ASTM F1216.

2.4 TESTING REQUIREMENT

A. Chemical Resistance - The Contractor shall certify that CIPP will meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing will be of liner and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

B. Hydraulic Capacity - The Contractor shall certify that the CIPP will have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition. The roughness coefficient of the CIPP will be verified by third-party test data.

C. CIPP Field Samples - When requested by the Owner, the Contractor shall submit test results from previous field installations in the USA of the same resin system and liner materials as proposed for the actual

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installation. These test results must verify that the CIPP physical properties specified in Section 2.3.D. have been achieved in previous field applications. Testing samples for this project will be made and tested as described in Section 3.4.A.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall secure his source of water. The Contractor may contact the Owner to determine whether water is available from the Owner and the associated cost.

B. It will be the responsibility of the owner to locate and designate all manhole access points open and accessible for the work and provide rights of access to these points. If a street must be closed to traffic because of the orientation of the sewer, the Contractor shall furnish and install all necessary traffic control devices until the street is opened to traffic.

C. Cleaning of Sewer Lines - The Contractor shall remove all internal debris out of the sewer line that will interfere with the installation of CIPP. The Contractor shall secure their disposal site for all debris removed from the sewers.

D. Bypassing Sewage - The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for the lining. The bypass will be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines will be of adequate capacity and size to handle the flow. Refer to section 33 31 31 - Sanitary Sewerage Piping Point Repair" of this Project Manual for additional bypass requirements.

E. Inspection of Pipelines - Inspection of pipelines will be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed-circuit television. The interior of the pipeline will be carefully inspected to determine the location of any conditions that may prevent proper installation of CIPP into the pipelines, and it will be noted so that these conditions can be corrected.

F. Line Obstructions - It will be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the proper insertion of CIPP. If pre-installation inspection reveals an obstruction such as a protruding service connection, offset joint, or a collapse that will prevent the inversion process, and it cannot be removed by conventional sewer cleaning equipment, the Contractor shall immediately notify the Owner. The Owner may choose to have the Contractor make a point repair excavation to uncover and remove or repair the obstruction. Such excavation will be considered as a separate pay item.

G. The Contractor shall notify the Owner prior to initiating cleaning and flushing and will coordinate his operations with the Owner.

H. The Contractor shall determine the length and diameter of the pipe to be lined prior to fabrication of the liner. No additional compensation will be paid for measured diameters, which vary from the measurements indicated on the plans or bid form.

I. The Contractor shall provide all necessary equipment, jigs, pipe pieces, sandbags, labor, etc. to install the CIPP tube through the available access locations provided and shown on the plans. The Contractor shall also cut open, reinstate, and prepare the edges of cut surfaces in a clean and orderly fashion to reopen the pipe within manholes that have been lined through. No additional compensation will be made for lined through manholes, and such items of work will be considered incidental to the contract.

3.2 NOTIFICATION

A. Notice required. At least six days before the start of lining, the Contractor shall provide notice, including the approximate schedule of lining, as described below.

1. Written notice must be given to the adult residents of buildings, and to the owner or administrator of any property directly served by the sewer to be lined.

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2. The notice must be mailed or hand-delivered to the owner or administrator of a childcare building, school building, commercial business, and/or industry.

3. The notice may be put on or under the door of each residence, one notice for each single-family building and one notice for each unit of a multi-unit building.

B. Contents of Notice to Residents, Administrator, and Owner. The notice will specify the days and the hours during which sewer service will be restricted.

C. Reminder Notice: A written, or verbal reminder notice will be delivered at least 24 or 48 hours prior to the actual work.

3.3 CONSTRUCTION REQUIREMENTS

A. CIPP installation will be in accordance with ASTM F1216, Section 7, or ASTM F2019, Section 6.4 with the following additional requirements:

1. Resin Impregnation - The quantity of resin used for liner impregnation will be sufficient to fill the volume of air voids in the liner with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process will be used. A roller system will be used to uniformly distribute the resin throughout the liner.

2. Liner insertion will be performed in accordance with the manufacturer's recommendations and in such a way to fully extend the liner to its termination point, hold the liner tight against the pipe wall, and produce dimples at service connections and flared ends at maintenance holes. Lubricants may be used, as necessary. Care will be taken so as not to overstress the felt fiber.

3. Unless otherwise indicated in the plans or authorized in writing by the Engineer, steam curing, water curing, and UV curing will all be considered as an acceptable cure method for this project.

(a) Steam Cure

(1) After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe.

(2) The equipment should be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin.

(3) The temperature and pressure maintained in the pipe and the duration of the cure period will be as recommended by the manufacturer.

(4) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

(5) Cooling:

1. The new pipe should be cooled to a temperature below 113 degrees Fahrenheit before relieving the internal pressure within the section.

2. Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end.

3. Care will be taken in the release of the head so that a vacuum will not be developed that could damage the newly installed pipe.

(b) Circulated Heated Water Cure

(1) After inversion is completed, a suitable heat source and water recirculation equipment are required to circulate heated water throughout the pipe.

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(2) The equipment should be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin.

(3) The heat source should be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge should be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during the cure.

(4) The temperature and pressure maintained in the pipe and the duration of the cure period will be as recommended by the manufacturer.

(5) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

(6) Cooling:

1. The new pipe should be cooled to a temperature below 100 degrees Fahrenheit before relieving the static head in the inversion stand pipe.

2. Cool-down may be accomplished by the introduction of cool water into the inversion stand pipe water to replace hot water being drained from a small hole made in the downstream end.

3. Care will be taken in the release of the head so that a vacuum will not be developed that could damage the newly installed pipe.

(c) UV Cure – Follow ASTM F2019, Section 6.6 & 6.7

(1) The approved system must utilize an outer and inner film to ensure that the liner remains intact during the insertion process and to protect the resin at all times during the installation and curing process from water and debris contamination and resin migration.

(2) A winch should be used to pull the glass fiber liner into position in the pipe. The pulling speed will not exceed 15.0-feet per minute. The liner will have a lateral fiberglass reinforcement band that runs the entire length of the liner ensuring that the pulling force is transferred to the band and not the fiberglass liner. Once inserted, end plugs will be used to cap each end of the glass fiber liner to prepare for pressurizing the liner. As with all CIPP products liner restraints should be used in manholes.

(3) A slip sheet will be installed on the bottom one-third to one-half of the pipe prior to liner insertion, to protect the liner during insertion and reduce the drag, or as recommended by the liner manufacture.

(4) The glass fiber liner will be cured with UV light sources at a constant inner pressure. When inserting the curing equipment in the liner, care should be taken to not damage the inner film material.

(5) The UV light sources should be assembled according to the manufacture's specification for the liner dimeter. For the liner to achieve the required water tightness and specified mechanical properties, the following parameters must be controlled during the entire curing process, giving the Engineer a record of the curing parameters over every segment of the entire length of the liner. This demonstrates that the liner is cured properly. The recording will include:

1. Curing Speed

2. Light Source and Wattage

3. Inner Air Pressure

4. Curing Temperatures

5. Date and Time

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6. Length of Liner

(6) This will be accomplished using a computer and database that are tamper-proof. During the curing process, infrared sensors will be used to record curing data that will be submitted to the Engineer with a post-CCTV inspection on the portable hard drive.

(7) The optimal curing speed, or travel speed of the energized UV light sources, is determined for each length of liner based on internal diameter, liner thickness, and exothermic reaction temperatures.

(8) The inner film material should be removed and discarded after curing to provide optimal quality of the final product.

B. The liner pipe will be continuous, without joints over the entire length of the pipe. The liner will be free of all visual and material defects, including but not limited to foreign inclusions, dry spots, pinholes, and delaminations. The surface will be smooth and free of waviness throughout the pipe.

C. Any defects that will affect the structural integrity or hydraulic capacity of the reconstructed pipe will be repaired or the liner will be replaced at the Contractor's expense, including large radial or longitudinal wrinkles that occur in such a size as to reduce the thickness or nominal diameter of the finished CIPP product.

D. Hydrophilic end seals are required to seal the ends of each CIPP liner as it connects to the manhole. These seals will be installed prior to CIPP to prevent water tracking between the CIPP product and the existing host pipe. End Seals will be LMK Insignia Seals or Engineer approved equal.

3.4 REINSTATEMENT OF SEWER SERVICE LATERALS

A. The Contractor shall certify he has a minimum of two complete working cutter units plus spare key components on the site before each inversion.

B. Prior to installing the sewer liner (during the television process), the Contractor shall locate, dye-test, and record the location of all sewer lateral connections that are in question. The Contractor shall immediately submit this information to the Owner. The Owner will then determine which, if any, sewer services are to be abandoned. Those services designated to be abandoned will not be reinstated.

C. After the sewer lining is complete, the Contractor shall re-establish all service connections except those designated by the Owner to be abandoned. This will be done without excavation from the interior of the pipe using a television camera and a remotely controlled cutting device.

1. If the Contractor is unable to re-establish the service connection from inside the pipe and excavation is necessary, no additional payment will be made for excavations to reopen connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

2. Reestablished service connections will be clean and smooth, free of jagged edges, and conform as closely as possible to the dimension of the existing service.

3. Brush-style cutters or similar devices will be required to ensure that the laterals are smooth for potential CIPP lateral lining.

D. The sewer main will be lined prior to lining service laterals, unless approved otherwise by the Engineer.

3.5 INSPECTION

A. CIPP samples will be prepared and tested in accordance with ASTM F1216, Section 8.1 using either method proposed.

B. Leakage testing of the CIPP will be accomplished during cure while under a positive head. CIPP products in which the pipe wall is cured while not in direct contact with the pressurizing fluid (e.g., a removable bladder) must be tested by an alternative method approved by the Owner.

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C. Visual observation of the CIPP will be in accordance with ASTM F1216, Section 8.4.

3.6 TELEVISING

A. Televising is required both prior to liner installation and after the CIPP process has been completed.

B. Televising will be performed by experienced personnel trained in locating breaks, obstacles, and service connections.

C. All televising videos will be in color. Each individual reach of pipe between manholes will be identified as a chapter on the video.

D. Immediately prior to televising, the televisor will discharge sufficient clear water into the pipe to clean the pipe and assist in identifying sags and misalignment.

E. Post-lining televising will carefully inspect the interior of the pipeline to identify any conditions which may indicate improper installation.

F. A DVD and suitable log will be kept of all televising and submitted to the Owner.

3.7 CLEAN-UP

A. Upon acceptance of the installation work and testing, the Contractor shall clean up the project area affected by the operations.

3.8 WARRANTY

A. All lining work will be fully guaranteed by the Contractor for 2 years from the date of Final Acceptance. During this period, all serious defects discovered by the Owner or Engineer will be removed and satisfactorily replaced by the Contractor at no cost to the Owner. In addition, the Owner may conduct independent televised inspections, at its own expense, of the lining work at any time prior to the completion of the guarantee period.

******END OF SECTION******

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SECTION 33 01 30.76 - CURED-IN-PLACE PIPE LINING – PRESSURE, NON-POTABLE

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to the installation of a resin-impregnated flexible liner that is inserted into the original conduit by use of a hydrostatic head. Methods that are pulled in and inflated rather than inverted will be considered, providing they meet the other provisions of this specification. When cured, the finished pipe (CIPP) will be continuous and tight-fitting. Due to the condition of the host pipe, the new CIPP will be designed as a fully structural pipe, not relying on the remaining strength or water tightness of the host pipe to withstand long-term external loading and internal pressure.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Measurement and compensation for the following items will be paid according to the referenced specification or as modified below:

1. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The furnishing and installing of specific items and /or the performance of work under certain circumstances will not be individually paid in the absence of a specific bid item for the work. The costs will be included in the unit price bid for the CIPP, as indicated. Such items of work include, but are not limited to:

1. Coordination with City to coordinate access to the sanitary sewer systems.
2. Securing and withdrawing from a water source.
3. Furnishing, installing and maintaining traffic control devices where necessary not already provided for by bid items.
4. Pre-installation and post-installation cleaning and televising.
5. Removal and disposal of internal debris from the sewer mainline and services prior to installation.
6. Bypass pumping not already provided for by bid items.
7. Providing all required notifications of restricted sewer service periods to the Owner and residents affected by the work as well as coordination of resident relocations and reimbursements, if applicable.
8. Installation of pipe pre-liners or grouting if required to install CIPP in areas of excess infiltration
9. Dye testing as required to determine active laterals (where needed).
10. Removal of liner in manholes if pulling/inverting through manholes (unless manhole is being abandoned).
11. Excavation and restoration required to reinstate sewer services if the Contractor is unable to reinstate services via trenchless methods.

1.3 SPECIFICATION REFERENCES

A. The specification references below are made a part hereof by such reference and will be the latest edition and revision thereof. In case of conflicting requirements between this specification and the ASTM referenced sections, this specification will govern.

B. The following referenced Specifications will apply to this Section:

1. ASTM F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastics (GRP) Cured-In-Place Pipe (CIPP)

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2. ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
3. ASTM F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and inflate and Curing of a Resin-Impregnated Tube.
4. ASTM F2561 – Standard Practice for Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One-Piece Main and Lateral Cured-in-Place Liner.
5. ASTM D543 Test Method for Resistance of Plastics to Chemical Reagents
6. ASTM D578 Standard Specification Glass Fiber Strands
7. ASTM D638 Standard Test Method for Tensile Properties of Plastics.
8. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
9. ASTM D2122 Standard 1 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
10. ASTM D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
11. ASTM D3567 Standard Practice for Determining Dimensions of ‘‘Fiberglass’’ (Glass-Fiber Reinforced Thermosetting Resin) Pipe and Fittings
12. ASTM D5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe

C. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Information Requested from the Low Bidder

1. Contractor will submit, prior to the installation or use of any lining materials or equipment, certified test results from the manufacturers which indicate that all materials conform to the applicable requirements.
2. A copy of the license or certificate verifying the manufacturer's or licensor's approval of the INSTALLER.
3. Chemical resistance submittals --- Contractor to submit test results of the resin proposed that meet the chemical resistance requirements of ASTM F2019, Section 5.2.6 and/or ASTM F 1216. The chemical resistance tests will be completed in accordance with Test Method D543.
4. CIPP Field Samples ---Field sampling procedure will be in accordance with ASTM 2019, ASTM F1216, and in accordance with ASTM D5813.
5. Hydraulic Capacity – The pipe lining will at a minimum achieve the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition. The roughness coefficient will be verified by test data.
6. Reinstatements –Contractor to submit details of how existing tees, wyes, air relief valves, blow-off valves, threaded taps, etc., will be reinstated. Reinstatements should provide a sufficient seal to prevent water tracking between the pipe lining and the host pipe.
7. MSDS Sheets --- Contractor to submit Material Safety Data Sheets for all resins, and other additives such as accelerants, colorants, and lubricants utilized in the pipe liner/lining process.
8. Manufacturer Protocols - Contractor to submit manufacturer information that describes the materials, curing speeds/schedule, curing installation processes, installation pressures, temperature limitations, and recommended post curing documentation.

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9. Residential Informational Handout - Contractor to submit an informational hand out that describes the materials, processes, installation, pressures, temperature limitations, and odors associated with the lining process that will be provided at the request of concerned residents.
10. Liner pipe thickness design for each pipe segment. No liner will be approved for installation until liner thickness calculations have been submitted and reviewed for conformance with the specification.
11. Proposed plan for temporary conveyance of sewer flows and bypass monitoring, including an emergency bypass backup plan.
12. Proposed construction schedule.
13. Evidence of the INSTALLER's experience including a list of similar projects completed within the previous 2 years.
14. Description of cure method(s) proposed by the Contractor.

B. Televising Log

1. All televising and construction logs, or copies thereof, will become the property of the Owner. This includes the videos made at the beginning of the project just prior to the installation of the liner.
2. Televising logs will be in provided in DVD format.
3. Two copies of all DVD's will be submitted.

PART 2 - PRODUCTS

2.1 PREQUALIFICATION

A. Only bids for pre-qualified products will be accepted. Bids submitted for products or from Contractors that have not been pre-qualified may be rejected, pending review by the Owner. The Contractor and the proposed method of reconstruction and the product manufacturer's name will be identified on the bid.

B. Hydraulic Capacity – The pipe lining will at a minimum achieve the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition. The roughness coefficient will be verified by test data.

C. Pre-qualified Products and Installers

1. Insituform Technologies USA, LLC.

   1140 Bunker Lake Boulevard NW, Anoka, MN 55303, Telephone: 651-762-1238

2. Michels Pipe Service – A Division of Michaels Corporation

   817 West Main Street, P.O. Box 128, Brownsville, WI 53006, Telephone: 920-583-3132

3. Sak Construction

   864 Hoff Road, O'Fallon, MO 63366, Telephone 626-385-1000

4. Fer-Pal Construction

   26187 Northline Road, Taylor, MI, 48180, Telephone 734-946-2034

5. IPR Industrial

   2002 Timberloch Place, Suite 550, The Woodlands, TX 77380, Telephone 404-966-1982

6. Granite Construction

   2950 Metro Drive # 200, Bloomington, MN 55425, Telephone 952-853-1252

D. Qualification Process

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1. Contractors wishing to qualify for this project must submit a copy of the license or certificate verifying the manufacturer's or licensor's approval, and evidence of the INSTALLER's experience including the number, total length, and locations of inversions installed to date using the proposed materials and methods together with the names and phone numbers of facility owners to the Engineer 5 days prior to the opening of bids to allow time for evaluation. The Contractor must have at least five (5) years of active experience installing the pressure-rated CIPP product.
2. The final decision to accept or reject the applicant lies solely with the Engineer and Owner. All decisions will be based upon the long-term best interest of the City.

2.2 MATERIALS

A. Liner - The liner material will meet the requirements of ASTM F1216 and/or ASTMF2019. The CIPP tube product will consist of one or more layers of absorbent woven and/or non-woven synthetic fiber, with glass reinforcement.

B. Resin - The resin system will meet the requirements of ASTM F1216 and/or ASTMF2019. A neat resin will be used for all lining of PVC pipes.

2.3 STRUCTURAL REQUIREMENTS

A. The CIPP will be designed as per ASTM F1216, Appendix X1.3.2.

B. The CIPP will be designed using a Long Term Creep Retention Factor of fifty percent of the initial design flexural modulus as determine by ASTM D-790 test method. This value will be used unless the Contractor submits long term test data (ASTM D2990) to substantiate a higher retention factor.

C. The layers of the cured CIPP will be uniformly bonded. It will not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers.

D. If separation of the layers occurs during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

E. The CIPP will conform to the following properties:

	Standard	**Min Value**	**UV Value**
Flexural Strength	ASTM - D790	7,000 psi	6,500 psi
Modulus of Elasticity	ASTM - D790	400,000 psi	725,000 psi
Tensile Strength	ASTM – D638	6,500 psi	6,500 psi

F. The design parameters for 6” to 8” diameter pipe is:

Pipe diameter	8	Inches
Internal Design Pressure (Not to exceed 150 psi)	150	PSI
Operating/Working Pressure	100	PSI
Maximum depth from finished ground to invert	8.0	Feet
Minimum depth from finished ground to invert	7.5	Feet
Groundwater Depth	Equal to Soil Depth	Feet
Cover density (assumed)	120	Lbs/cf
Design Safety Factor (1.5 for pipes 36 inches and larger)	2.0	Value
Ovality	2.0%	Percent
Enhancement Factor (K)	7.0	Value
Poisson’s Ratio	0.3	Value
Level of Deterioration	Fully Det.	Value
Creep Retention Factor	50%	Value
Live load requirement	H20 Highway	Value

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G. The required structural CIPP wall thickness will be based as a minimum, on the physical properties listed above and in accordance with the Design Equations in the appendix of ASTM F1216. The finished/cured liner thickness will exceed minimum thickness requirements set forth by the equations in the appendix of ASTM F1216.

2.4 TESTING REQUIREMENT

A. Chemical Resistance - Contractor will certify that CIPP meets the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing will be of liner and resin system like that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

B. Hydraulic Capacity - Contractor will certify that the CIPP has a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition. The roughness coefficient of the CIPP will be verified by third party test data.

C. CIPP Field Samples - When requested by the Owner, Contractor will submit test results from previous field installations in the USA of the same resin system and liner materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in 2.3.D. of this Section have been achieved in previous field applications. Testing samples for this project will be made and tested as described in 3.4.A. of this Section.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall secure his source of water. The Contractor shall contact the Owner to determine whether water is available from the Owner and the associated cost.

B. It will be the responsibility of the Owner to locate and designate all manholes or access points open and accessible for the work and provide rights of access to these points. If a street must be closed to traffic because of the orientation of the sewer, The Contractor shall furnish and install all necessary traffic control devices until the street is opened to traffic.

C. Cleaning of Sewer Lines – The Contractor shall remove all internal debris out of the sewer line that will interfere with the installation of CIPP. If the CIPP product relies on bonding to the existing host pipe, the pipe must be clean to bear metal such that the newly installed product bonds and the void between the two pipes are water-tight. Pipes will be cleaned by the Contractor using high-velocity jet cleaners, mechanically powered equipment, cable-attached devices, or fluid-propelled devices. The Contractor to secure their disposal site for all debris removed from the sewers.

D. Bypassing Sewage – The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for the lining. The bypass will be made by plugging the line at an existing upstream manhole (or lift station) and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines will be of adequate capacity and size to handle the flow.

E. Inspection of Pipelines - Inspection of pipelines will be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed-circuit television. The interior of the pipeline will be carefully inspected to determine the location of any conditions that may prevent proper installation of CIPP into the pipelines, and it will be noted so that these conditions can be corrected.

F. Line Obstructions – The Contractor shall be responsible for clearing the line of obstructions such as solids and roots that will prevent the proper insertion of CIPP. If pre-installation inspection reveals an obstruction such as a protruding service connection, offset joint, or a collapse that will prevent the inversion process, and it cannot be removed by conventional sewer cleaning equipment, The Contractor shall immediately notify the Owner. The Owner may choose to have the Contractor make a point repair excavation to uncover and remove or repair the obstruction. Such excavation will be considered as a separate pay item.

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G. The Contractor shall notify the Owner prior to initiating cleaning and flushing and will coordinate his operations with the Owner.

H. The Contractor shall determine the length and diameter of the pipe to be lined prior to fabrication of the liner. No additional compensation will be paid for measured diameters, which vary from the measurements indicated on the plans or bid form.

I. The Contractor shall provide all necessary equipment, jigs, pipe pieces, sandbags, labor, etc. to install CIPP tubes through these manholes. The Contractor shall also cut open, reinstate, and prepare the edges of cut surfaces in a clean and orderly fashion to reopen the pipe within manholes that have been lined through (gravity portions only). No additional compensation will be made for lined through manholes, and such items of work will be considered incidental to the contract.

J. The Contractor shall isolate or remove (and then replace after) any air release valves from the pipeline section prior to installation.

3.2 NOTIFICATION

A. Notice required. At least six days before the start of lining, the Contractor shall provide notice, including the approximate schedule of lining, as described below.

1. Written notice must be given to the adult residents of buildings, and to the owner or administrator of any property directly served by the sewer to be lined.

2. The notice must be mailed or hand-delivered to the owner or administrator of a childcare building, school building, commercial business, and/or industry.

3. The notice may be put on or under the door of each residence, one notice for each single-family building and one notice for each unit of a multi-unit building.

B. Contents of Notice to Residents, Administrator, and Owner. The notice will specify the days and the hours during which sewer service will be restricted.

C. Reminder Notice: A written, or verbal reminder notice will be delivered at least 24 or 48 hours prior to the actual work.

3.3 CONSTRUCTION REQUIREMENTS

A. CIPP installation will be in accordance with ASTM F1216, Section 7, or ASTM F2019, Section 6.4 with the following additional requirements:

1. Resin Impregnation - The quantity of resin used for liner impregnation will be sufficient to fill the volume of air voids in the liner with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process will be used. A roller system will be used to uniformly distribute the resin throughout the liner.

2. Liner insertion will be performed in accordance with the manufacturer's recommendations and in such a way to fully extend the liner to its termination point, hold the liner tight against the pipe wall, and produce dimples at service connections and flared ends at maintenance holes. Lubricants may be used as necessary. Care will be taken so as not to overstress the felt fiber.

3. Unless otherwise indicated in the plans or authorized in writing by the Engineer steam curing, water curing, and UV curing will all be considered as acceptable curing methods for this project.

(a) Steam Cure

(1) After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe.

(2) The equipment should be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin.

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(3) The temperature and pressure maintained in the pipe and the duration of the cure period will be as recommended by the manufacturer.

(4) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

(5) Cooling:

1. The new pipe should be cooled to a temperature below 113 degrees Fahrenheit before relieving the internal pressure within the section.

2. Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end.

3. Care will be taken in the release of the head so that a vacuum will not be developed that could damage the newly installed pipe.

(b) Circulated Heated Water Cure

(1) After inversion is completed, a suitable heat source and water recirculation equipment are required to circulate heated water throughout the pipe.

(2) The equipment should be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin.

(3) The heat source should be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge should be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during curing.

(4) The temperature and pressure maintained in the pipe and the duration of the cure period will be as recommended by the manufacturer.

(5) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

(6) Cooling:

1. The new pipe should be cooled to a temperature below 100 degrees Fahrenheit before relieving the static head in the inversion standpipe.

2. Cool-down may be accomplished by the introduction of cool water into the inversion standpipe water to replace hot water being drained from a small hole made in the downstream end.

3. Care will be taken in the release of the head so that a vacuum will not be developed that could damage the newly installed pipe.

(c) UV Cure – Follow ASTM F2019, Section 6.6 & 6.7

(1) The approved system must utilize an outer and inner film to ensure that the liner remains intact during the insertion process and to protect the resin at all times during the installation and curing process from water and debris contamination and resin migration.

(2) A winch should be used to pull the glass fiber liner into position in the pipe. The pulling speed will not exceed 15ft/min. The liner will have a lateral fiberglass reinforcement band that runs the entire length of the liner ensuring that the pulling force is transferred to the band and not the fiberglass liner. Once inserted, end plugs will be used to cap each end of the glass fiber liner to prepare for pressurizing the liner. As with all CIPP products liner restraints should be used in manholes.

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(3) A slip sheet will be installed on the bottom one-third to one-half of the pipe prior to liner insertion, to protect the liner during insertion and reduce the drag, or as recommended by the liner manufacture.

(4) The glass fiber liner will be cured with UV light sources at a constant inner pressure. When inserting the curing equipment in the liner, care should be taken to not damage the inner film material.

(5) The UV light sources should be assembled according to the manufacture's specification for the liner dimeter. For the liner to achieve the required water tightness and specified mechanical properties, the following parameters must be controlled during the entire curing process, giving the Engineer a record of the curing parameters over every segment of the entire length of the liner. This demonstrates that the liner is cured properly. The recording will include:

1. Curing Speed
2. Light Source and Wattage
3. Inner Air Pressure
4. Curing Temperatures
5. Date and Time
6. Length of Liner

(6) This will be accomplished using a computer and database that are tamper-proof. During the curing process, infrared sensors will be used to record curing data that will be submitted to the Engineer with a post-CCTV inspection on the portable hard drive.

(7) The optimal curing speed, or travel speed of the energized UV light sources, is determined for each length of liner based on internal diameter, liner thickness, and exothermic reaction temperatures.

(8) The inner film material should be removed and discarded after curing to provide optimal quality of the final product.

B. The liner pipe will be continuous, without joints over the entire length of the pipe. The liner will be free of all visual and material defects, including but not limited to foreign inclusions, dry spots, pinholes, and delaminations. The surface will be smooth and free of waviness throughout the pipe.

C. Any defects that will affect the structural integrity or hydraulic capacity of the reconstructed pipe will be repaired or the liner will be replaced at the Contractor's expense, including large radial or longitudinal wrinkles that occur in such a size as to reduce the thickness of the finished CIPP product. A minor internal longitudinal fold may be present when using the aqua-pipe product to ensure surface contract throughout the liner.

3.4 INTERNAL END SEALS AND REINSTATEMENTS

A. The Contractor shall install end seals at the pipe lining beginning and termination point, or appropriate sealing technology as required by the manufacture.

B. The end seals will be a mechanical expansion type, constructed of stainless steel and elastomeric seals. The end seals will be rated by the manufacturer for the operating pressure and will be compatible with the piped fluid. The pipe at the end seal installation point will be structurally sound and free of any significant pitting or heavy corrosion. This is required to ensure an adequate seal between the liner and the host pipe. Otherwise, replacement with a new steel/plastic spool piece at these ends may be required.

C. All reinstatements of tees, wyes, air relief valves, blow-off valves, threaded taps, etc., will be completed following the approved procedures identified in the submittal described in Section 1.4.A.6. of this Section.

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3.5 REINSTATEMENT OF SEWER SERVICE LATERALS

A. The Contractor shall certify he has a minimum of two complete working cutter units plus spare key components on the site before each inversion.

B. Prior to installing the sewer liner (during the television process), The Contractor shall locate, dye-test, and record the location of all sewer lateral connections that are in question. The Contractor shall immediately submit this information to the Owner. The Owner shall then determine which, if any, sewer services are to be abandoned. Those services designated to be abandoned will not be reinstated.

C. After the sewer lining is complete, The Contractor shall re-establish all service connections except those designated by the Owner to be abandoned. This will be done without excavation from the interior of the pipe using a television camera and a remotely controlled cutting device.

1. If the Contractor is unable to re-establish the service connection from inside the pipe and excavation is necessary, no additional payment will be made for excavations to reopen connections and the Contractor shall be responsible for all costs and liability associated with such excavation and restoration work.

2. Reestablished service connections will be clean and smooth, free of jagged edges, and conform as closely as possible to the dimension of the existing service.

3. Brush-style cutters or similar devices will be required to ensure that the laterals are smooth for potential CIPP lateral lining.

D. The sewer main will be lined prior to lining service laterals, unless approved otherwise by the Engineer.

3.6 INSPECTION

A. CIPP samples will be prepared and tested in accordance with ASTM F1216, Section 8.1 using either method proposed.

B. Visual observation of the CIPP will be in accordance with ASTM F1216, Section 8.4.

C. Pressure testing for water-tightness will be provided on all CIPP sections.

D. Perform hydrostatic pressure test on the lined pipeline, following the guidelines of AWWA C600. A recommended pressure and leakage test would be twice the known working pressure or at the working pressure plus 50 psi, whichever is less.

3.7 TELEVISING

A. Televising is required both prior to liner installation and after the CIPP process has been completed.

B. Televising will be performed by experienced personnel trained in locating breaks, obstacles, and service connections.

C. All televising videos will be in color. Each individual reach of pipe between manholes will be identified as a chapter on the video.

D. Immediately prior to televising, the televisor will discharge sufficient clear water into the pipe to clean the pipe and assist in identifying sags and misalignment.

E. Post-lining televising will carefully inspect the interior of the pipeline to identify any conditions which may indicate improper installation.

F. A DVD and suitable log will be kept of all televising and submitted to the Owner.

3.8 CLEAN-UP

A. Upon acceptance of the installation work and testing, the Contractor shall clean up the project area affected by the operations.

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B. Upon acceptance of the installation, the Contractor or Owner, as specified by contract documents, will return the piping system to service by the closure of all access pits with appropriate pipe spools, valves, and other relevant fittings.

C. Reconnection of the CIPP lined pipe will be required at all access pits. The Contractor, as specified by contract documents, will provide watertight reconnections to the CIPP lined pipe. If connections are made utilizing the existing pipe (and not directly to the CIPP pipe), resin will be applied to the end of the pipe to prevent water tracking between the existing pipe and the newly lined CIPP product.

3.9 WARRANTY

A. All lining work will be fully guaranteed by the Contractor for a period of 5 years from the date of Final Acceptance unless otherwise stipulated in writing by the Owner prior to the date of Conditional Acceptance. During this period, all serious defects discovered by the Owner or Engineer will be removed and replaced by the Contractor in a satisfactory manner at no cost to the Owner. In addition, the Owner may conduct independent televised inspections, at its own expense, of the lining work at any time prior to the completion of the guarantee period.

******END OF SECTION******

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SECTION 33 01 30.86 - MANHOLE RIM ADJUSTMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment and performances of all work and services necessary or incidental to adjusting a casting assembly frame and ring or valve box as indicated on the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. MnDOT 2506 shall apply to adjusting frame and ring, except as modified herein.

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. No submittals for this section.

PART 2 - PRODUCTS

2.1 ADJUSTING RINGS

A. Only Ladtech H.D.P.E adjusting rings or approved equal, with approved mastic, shall be permitted for new manhole and catch basin installations and for manhole chimney repairs.

(a) For sanitary manholes, if necessary to fit with the chimney seal, the Contractor may cut the tab off the bottom ring.

(b) For sanitary manholes, the chimney seal shall be sealed to the manhole cone section using Infi-Shield External Gator Wrap. The wrap shall be placed on the exterior extending a minimum of 3.0-inches onto the cone section. The barrier shall extend up into the manhole casting to a point approximately 2.0-inches below the manhole cover.

(c) Adjusting rings for storm manholes and catch basins shall be completely encased in Infi-Shield Gator Wrap. The wrap shall be installed per the manufacturer's recommendations and shall extend a minimum of 3.0_inches past the adjusting rings onto the drainage structure and casting to create a water-tight seal.

2. Concrete Adjusting Rings (Catch Basin Repairs Only)

(a) The Contractor shall bring castings to grade. The casting shall be placed on a full mortar bed or bituminous mastic upon final setting. The inside and outside of the adjusted area shall be plastered with a minimum thickness of ½-inch mortar.

3. Adjusting rings shall be completely encased in Infi-Shield Gator Wrap. The wrap shall be installed per the manufacturer's recommendations and shall extend a minimum of 3-inches past the adjusting rings onto the drainage structure and casting to create a water-tight seal.

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PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The Contractor shall bring manhole castings and valve boxes to grade. The manhole casting shall be placed on a full mortar bed or bituminous mastic upon final setting. The inside and outside of the adjusted area shall be plastered with a minimum thickness of 1/2-mortar.

B. All inverts of manholes and valves boxes shall be cleaned of debris and gravel which may have fallen into the structures as a result of construction.

C. Finished grade of the casting or valve box in paved areas shall be according to the following, unless otherwise specified on the plans:

	Distance Below Adjacent Concrete Pavement (in)	Distance Below Adjacent Bituminous Pavement (in)	Distance Below Adjacent Gravel Surface/Green Area (in)
City Streets	1/8 to ¼	¼ to 3/8	1
County Highways	1/8 to ¼	¼ to 3/8	1
State Highways	1/8 to ¼	¼ to 3/8	1
Sidewalks	1/8 to ¼	1/8 to ¼	1
Parking Areas	1/8 to ¼	¼ to 3/8	1

D. In no case shall the casting or valve box extend above the finished surface.

E. Raising and/or lowering an existing manhole to meet a proposed finished rim elevation is performed when the addition and/or deletion of 2.0-inch adjusting rings will not reach a minimum of 2 rings or exceed a maximum of 6 rings. Typically, it will require the:

1. Removal of the manhole cone section or concrete slab top
2. Addition, removal, or exchange of barrel sections
3. Replacement of the cone section or the flat slab top
4. Installation of the proper number of adjusting rings.
5. Replacement of the manhole frame and casting.
6. In some cases, the existing structure may require saw cutting.

******END OF SECTION******

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SECTION 33 05 06 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to the maintenance of utility service, trench excavation, bedding, and backfill necessary for the construction of underground utilities and structures, as indicated on the drawings or as specified herein.

1.2 DEFINITIONS

A. Excess Material - Material that is not needed to complete the earthwork balance.

B. Suitable Material - Sand, silty sand, or low plasticity clay soils with no organic content. The Engineer shall make the final determination as to what material will be considered suitable.

C. Unsuitable Material - Soil with organic content including topsoil, swamp deposits, peat, muck, or other material deemed by the Engineer to be unsuitable for fill or embankment construction.

D. Flexible Pipe Materials – For this specification section, flexible pipe materials will include the following:

1. Polyvinyl chloride (PVC) pipe – solid wall and profile wall pipe.
2. Polypropylene profile wall pipe.
3. High-density polyethylene pipe – solid wall and profile wall pipe.
4. Corrugated steel or aluminum pipe.
5. Centrifugally cast glass-fiber-reinforced, polymer mortar (CCFRPM) pipe.

E. Rigid Pipe Materials – For this specification section, rigid pipe materials will include the following:

1. Reinforced concrete pipe.
2. Reinforced concrete box culverts.
3. Ductile iron pipe.

1.3 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section will be included in the Lump Sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.4 SPECIFICATION REFERENCES

A. CEAM 2600 will apply, except as modified herein.

B. MnDOT 2451 will apply, except as modified herein.

C. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.5 SUBMITTALS

A. Gradation Test Results for any granular borrow materials.

B. Two separate tests, as required in Source Quality Control provisions of individual sections contained herein, from material stockpiles of aggregates to be used on this project. These tests may be run by the Contractor or its supplier during aggregate production.

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PART 2 - PRODUCTS

2.1 GRANULAR MATERIALS

A. Granular Bedding and Granular Encasement – No exception to the referenced specification is made.

B. Granular Backfill - No exception to the referenced specification is made.

PART 3 - EXECUTION

3.1 EXCAVATION AND PREPARATION OF TRENCH

A. Interference and Protection of Underground Structures

1. If an existing utility is shown on the plans and there is no bid item for removing and restoring, or working around the utility, the Contractor shall be required to remove and restore, or protect the utility.

2. The inverts of existing sewers (storm & sanitary), culverts, subdrains, etc. will be protected during construction. The Contractor is responsible to inspect and clean, if necessary, all lines which have become compromised by the construction operations.

B. Excavation Limits and Requirements

1. The trench for all flexible pipe will be undercut 6.0-inches below the pipe barrel to permit the installation of granular bedding or foundation material.

2. The trench for all rigid pipe will be undercut 3.0-inches below the pipe barrel, or as shown in the bedding detail, to permit the installation of granular bedding or foundation material.

3. The Contractor shall install and operate a dewatering system to maintain all trenches free of water wherever necessary. The Contractor shall make their subsurface investigations and determine what dewatering methods to utilize to prevent such damage.

4. The Contractor shall be responsible for any damage to adjacent structures or buildings caused by the dewatering operations.

5. Use of granular foundation material in place of performing dewatering is permitted.

6. All excess excavated material will become the property of the Contractor and will be removed from the site and disposed of at a location secured by the Contractor.

3.2 INSTALLATION OF PIPE AND FITTINGS

A. The Contractor shall keep accurate records as to the location of the service connections, field tile, utility crossings, etc. either constructed or encountered during the construction Measurements to service lines will be taken from the two nearest permanent structures (i.e., hydrants, valves, manholes, buildings). Final payment for the project will not be made until the information is in the possession of the Owner.

B. When connection to an existing conduit is required at an existing or proposed manhole, the Contractor shall expose and verify the elevation of the existing conduit before laying any pipe toward, or away from, the connection point. If the elevation of the existing conduit does not match the elevation shown on the plans, the Contractor shall notify the Engineer, at which time the Engineer may adjust the proposed grades.

C. Sewer Pipe at Structures

1. The pipe end(s) will be extended inside the structure a maximum of 3.0-inches unless approved otherwise by the Engineer or shown on the plans.

D. Connection and Assembly of Joints

1. For sanitary sewer, watermain, forcemains, and culverts, all joints will be water-tight.

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2. For storm sewers and subdrains, all joints will not permit the intrusion of soil or backfill materials.

   (a) If a reinforced concrete pipe is used, the Contractor may at its discretion choose to wrap each joint with a geotextile filter fabric, as specified, rather than place mastic in the joint.

E. Bulkheading Open Pipe Ends

1. The Contractor shall furnish, install and maintain a temporary, water-tight plug adequately blocked in place to prevent flooding of the existing downstream sewer system. The plug will be placed at the beginning of the project or the end of each working day at the end of the day's operation.

2. When flows are diverted from an existing sewer or tile to be abandoned in place, the Contractor will construct a water-tight plug on the open end of the abandoned pipe.

3. Permanent watertight plugs will be constructed with concrete grout with a thickness of not less than 1 pipe diameter.

3.3 BEDDING AND BACKFILLING OPERATIONS

A. Backfill material around all manholes, catch basins, valve boxes, curb boxes, and hydrants will be compacted with hand machines. The maximum lift thickness will be 6.0-inches.

B. Flexible Pipe Materials

1. Unless otherwise shown on the plans, the pipe will be bedded and backfilled with granular material compacted to 95 percent Standard Proctor Density or as recommended by the pipe manufacturer, whichever is denser, from 6.0-inches below the bottom of the pipe to 12.0-inches above the top of the pipe the full width of the trench. The Contractor shall bed and backfill the pipe as shown on the plan details.

2. Where the trench foundation is unstable and not suitable for bedding, the trench will be undercut until acceptable conditions are found. The Contractor shall then install compacted foundation material to meet the line and grade specified on the plan.

3. Unless otherwise shown on the plans, select native material will be used as a trench backfill above the granular bedding up to the bottom of the subgrade except in those conditions where the top of the pipe is less than 12.0-inches from the bottom of the subgrade in which case granular material compacted to 100 percent Standard Proctor Density will be used as trench backfill the full width of the trench to the bottom of the subgrade excavation zone.

C. Rigid Pipe Materials

1. Unless otherwise shown on the plans, in ordinary or stable trench conditions, the bottom of the trench will be first excavated to a depth of approximately 15 percent of the outside pipe diameter below the established grade for the bottom of the pipe. Then the bottom of the trench will be further excavated to allow for the placement of 6.0-inches of granular bedding for a width of at least 60 percent of the outside diameter of the pipe. A pipe will be placed on the bottom of the pre-shaped excavated trench. The bottom of the excavated trench will be shaped to fit the circumference of the pipe up to 0.15 of the outside diameter of the pipe. The Contractor shall encase the pipe from the 0.15 outside diameter to the 0.60 diameter height of the pipe with granular material compacted to 95 percent Standard Proctor Density or as recommended by the pipe manufacturer, whichever is denser.

2. Where the trench foundation is unstable and not suitable for bedding, the trench will be undercut until acceptable conditions are found. The Contractor shall then install compacted foundation material to meet the line and grade specified on the plan.

3. Unless otherwise shown on the plans, select native material may be used as trench backfill above the granular bedding up to the bottom of the subgrade except in those conditions where the top of the pipe is less than 12.0-inches from the bottom of the subgrade in which case granular material

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compacted to 100 percent Standard proctor Density will be used as trench backfill the full width of the trench to the bottom of the subgrade excavation zone.

D. Structures

1. All manholes, catch basins, valve boxes, water vaults, headwalls, and miscellaneous structures will be backfilled with granular backfill material and will be compacted with a hand-operated motorized compactor.

E. All trench backfill will be compacted in accordance with the Quality Compaction Method.

3.4 SOURCE QUALITY CONTROL

A. The Contractor shall arrange for having the following testing performed:

1. One gradation test per every 500 tons or 275 cu yd (CV) of granular materials.

3.5 FIELD QUALITY CONTROL

A. No exception to the referenced Specification is made.

*****END OF SECTION*****

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SECTION 33 14 00 - WATER UTILITY TRANSMISSION AND DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to watermain and service line construction as indicated on the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section will be included in the Lump Sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. The following referenced Specifications will apply to this Section:

1. ANSI/AWWA C550 and C116/A21.16
2. ASTM D1248
3. ASTM D1784
4. ASTM D2513
5. ASTM D3261
6. ASTM D3350
7. ASTM D2412
8. ASTM D3034
9. AWWA C651
10. AWWA C900
11. AWWA C906
12. CEAM 2611

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Work plan for temporary water service.

B. Watermain and Water Service Lines

1. Hydrants - Certificates of Compliance.
2. Valves & boxes - Certificates of Compliance.
3. Pipe & fittings - Certificates of Compliance.
4. Corporation stops, saddles, curb stops, curb boxes, copper pipe - Certificates of Compliance.

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PART 2 - PRODUCTS

2.1 THREADED ITEMS

A. All threaded items furnished under this contract, including but not limited to mechanical joint connectors, flanged joint connectors, mainline valves, saddles, corporation stops, curb stops, hydrants, and air release valves will be furnished to the nominal size as specified with ENGLISH threads.

2.2 OPEN CUT WATERMAIN MATERIAL

A. The following water pipe materials will be allowed for use on this project:

1. Ductile Iron Pipe, Class 52 with conductivity strips will be used.

2.3 WATERMAIN FITTING MATERIALS

A. The following pressure pipe fitting materials will be allowed for use on this project:

1. Mechanical Class 350 ductile iron fittings will be used.
2. All fittings will be coated with a 6-8 mil nominal thickness fusion bonded epoxy conforming to the requirements of ANSI/AWWA C550 and C116/A21.
3. All fittings, valves, hydrants, and restraining rods will be protected by using sacrificial zinc anode caps, ASTM B418 6 oz. Large Zinc Anode Caps as manufactured by Trumbull Industries Inc., or an approved equal. Contractors shall supply 2 anode caps per mechanical joint gland installed.
4. All fittings, valves, hydrants, etc., will be secured utilizing COR-BLUE T-BOLTS as manufactured by NSS Industries or approved equal.
5. All Restraining devices (megalugs) will be coated with a 6-8 mil nominal thickness, fusion bonded epoxy conforming to the requirements of ANSI/ AWWA C550 and C116/A21.
6. Adaptors, backup rings, and oversize sleeves will be provided for transitions and connections to dissimilar types of pipe materials. All sleeve fittings will be long mechanical joints.
7. All fittings will have been manufactured in the year of construction or prior calendar year.
8. Quality control of all fitting manufacturers will conform to the requirements of the International Organization for Standardization (ISO).

2.4 FIRE HYDRANTS

A. Hydrants will be WB67-250, 250 psi rating and will be furnished in a red color conforming to City standards. The bury length will be 8.0-feet unless otherwise noted on the plans. The Contractor shall install all hydrants so that the center of the nozzle is 24.0-inches above the finished grade. The City shall be contacted before ordering the hydrant to verify the correct nozzle threads and type of operating nut and cap bolts.

1. All Hydrants will have a 5½-inch main valve opening, one 4½-inch pumper outlet with Minneapolis Standards threads, and two 2½-inch hose outlets with National Standards threads. The size and shape of the operating nuts will be the national standards for a 1½-inch pentagon nut. Hydrants will be left opening, and an arrow indicating the direction of the opening will be marked on the hydrant.
2. All Hydrants will have a "break-off" stem and flange located in a common horizontal plane approximately 15.0-inches below the centerline of the 4½-inch outlet. The "break-off" feature will be so designed as to accommodate rotation of the upper barrel and the installation of extension sections.
3. All hydrant extensions will be manufactured by the same manufacturer as the hydrant.
4. The local fire department will be contacted before ordering hydrants to obtain the correct nozzle threads and type of operating nut and cap bolts.

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2.5 VALVE AND VALVE HOUSING

A. All water valves will have been manufactured in the year of construction or prior two calendar years.

B. All nuts and bolts will be 304 stainless steel.

C. Valve Housing

1. Cast-iron screw-type valve boxes will be installed where indicated on underground valves. The cast-iron valve boxes will be of either the two-piece or three-piece style and will be furnished with a stay-put cover with raised letters indicating "WATER." The shaft will be 5 ¼-inch inside diameter.

2. All valve box assemblies will be furnished with a valve umbrella anchorage assembly. The valve umbrella anchorage will be manufactured by Adaptor, Inc., Oak Creek, WI, or equal.

D. Gate Valves

1. All valves up to and including 12.0-inch diameter to be furnished and installed on the watermain will be AWWA C-509 <current edition>, non-rising stem, iron body, resilient-seated gate valves, with two-inch square opening nut rated for a 200 psi working pressure. These valves will be Waterous or approved equal. All valves will open 'left'.

E. Butterfly Valves

1. All valves larger than the 12.0-inch diameter to be furnished and installed on the watermain will be AWWA C-504, as manufactured by Waterous or an approved equal. All valves will open 'left'.

2.6 WATER SERVICE PIPE AND FITTINGS

A. Service Pipe and Fittings

1. General

(a) Water service pipe and fittings will conform to the provisions of 2611.2D, AWWA C800, and the following:

(1) Valves and fitting models vary according to watermain pipe size. See mfg. catalog data.

(2) Curb boxes will be adjustable from 7.0-feet to 8.0-feet in length with Minneapolis Pattern. Stationary rods are required.

(3) Water service materials will be manufactured in the U.S.A.

(4) Saddles will be provided for all corporation stops larger than 1½-inches if DIP pipe is installed.

2. Copper Service Pipe Notes & Specifications:

(a) Copper pipe will conform to ASTM B88, Seamless Copper Water Tubing, Type K, Soft Annealed Copper.

(b) Copper water service pipe connections will be compression type.

(c) Copper water service pipe will be continuous from the corporation stop to the curb stop.

3. The Utility should be contacted before ordering to verify the manufacturers' type and style. The water service materials style commonly used by the Utility are to be considered as a basis for quality are:

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WATER SERVICE PIPE & APPURTENANCES				
ITEM:	SERVICE PIPE SIZE	COMPRESSION TYPE Valves & Fittings For POLYETHYLENE PIPE		
		FORD MODEL #		MUELLER MODEL #
Corporation Stop		FORD		MUELLER
	3/4"	FB1000-3-Q-NL		B-25008-N
	1"	FB1000-4-Q-NL		B-25008-N
	1.25”	FB1000-5-Q-NL		N/A
	1.5"	FB1000-6-Q-NL		B-25008-N
	2"	FB1000-7-Q-NL		B-25008-N
Tapping Saddle		FORD for DIP WMN	FORD for PVC WMN	MUELLER
	3/4"	F202	FS323	N/A
	1"	F202	FS323	N/A
	1.25”	F202	FS323	N/A
	1.5"	F202	FS323	N/A
	2"	F202	FS323	N/A
Curb Stop		FORD		MUELLER
	3/4"	B44-333M-Q-NL		B-25155-N
	1"	B44-444M-Q-NL		B-25155-N
	1.25”	B44-555M-Q-NL		N/A
	1.5"	B44-666M-Q-NL		B-25155-N
	2"	B44-777M-Q-NL		B-25155-N
Curb Box	1.5” Diam. Base Tap for ¾” to 1.25” Curb Stops	FORD 8'- EM2-80-56		H-10300
Curb Box	2" Diam. Base Tap for 1.5" to 2" Curb Stops	FORD 8'- EM2-80-57		N/A

2.7 RESTRAINED JOINT RETAINER GLANDS

A. Where stainless steel is not used restrained joint retainer glands shall be coated with a 6-8 mil nominal thickness fusion bonded epoxy conforming to the requirements of ANSI/AWWA C550 and C116/A21.16 or approved equal.

2.8 POLYETHYLENE ENCASEMENT

A. The Contractor shall furnish and install polyethylene encasement for the entire main and all appurtenances in accordance with the referenced specification.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Temporary Service

1. Before proceeding with the project, the Contractor shall establish a work plan and submit the plan to the utility personnel and Engineer for review and comment. The plan will outline the method to be

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used to maintain service to the affected consumers and estimate the duration of any anticipated interruptions of service. The plan will include provisions to fully disinfect all temporary piping, valves, and fittings in accordance with CEAM Specification No. 2611. The Contractor is the sole party responsible to notify the Utility and consumers who may be affected by limitations and/or interruption of water service. Planned service interruptions will not exceed 6 hours in any 72 hour period unless previously approved by the Utility.

2. The Contractor shall coordinate watermain shut-downs with the water utility at least 24 hours before the requested shut-down.

3. If the Contractor fails to provide water service to affected residents within the constraints specified above, an amount equal to $500.00 may be deducted from the amount due to the Contractor for each occurrence.

3.2 INSTALLATION OF PIPE AND FITTINGS

A. Aligning and Fitting of Pipes

1. The Contractor, together with the utility's personnel, will jointly examine and operate all curb stops and mainline valves prior to final acceptance.

2. Anchoring of Pipe

(a) A thrust block of cast-in-place concrete, which covers the installed fitting, is not permitted. Restrained joint retainer glands will be provided at all bends, tees, hydrants, valves, and plugged crosses or wherever the watermain changes direction or dead ends

B. Polystyrene Insulation

1. The Contractor shall install polystyrene insulation in those areas where the watermain or services may be susceptible to frost or freezing, or as directed by the Engineer.

2. Rigid foam insulation will be placed between the watermain and storm or sanitary sewer where adequate vertical clearance cannot be maintained. The insulation will be placed on a bed of sand and sand will be placed above the insulation to isolate the insulation from rocks and other sharp objects. The ultimate thickness of insulation required will be achieved by using 2 layers of insulation, the second layer will be placed perpendicular to the first layer and the joints will be offset.

C. Water Service Installation

1. The Contractor shall keep accurate records as to the location of the service connections, as specified in the referenced specification. Final payment for the project will not be made until the information is in the possession of the Owner.

2. No warranty is expressed or implied as to the location, size, or material type of existing service lines. The Contractor shall furnish and install all fittings required to make the connections.

3. The Contractor shall install a new service pipe, at 7.0-foot bury depth, from the corporation stop to the property line, or as shown on the plans, or as directed by the Engineer.

4. The water services will be hydrostatically tested and disinfected.

5. All water services will be verified as operative and the corporation stops will be turned to open position prior to backfilling.

6. Contractor shall collect photos as described in Section 01 33 00 “Submittals Procedures” of this project manual prior to backfilling.

D. Polyethylene Encasement

1. The Contractor shall furnish and install polyethylene encasement for the entire main and all appurtenances in accordance with the referenced specification.

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E. Utility Location System

1. The Contractor shall install an underground utility location system (tracer wire) with all watermain and services in accordance with Section 33 05 97.36 "Underground Utility Location System" of this Project Manual.

3.3 FIELD QUALITY CONTROL

A. Hydrostatic Testing

1. Hydrostatic tests will be conducted in accordance with the referenced specification. Individual tests from valve to valve are required. These tests will be conducted prior to the bacteriological tests required with the disinfection of the main. No drop in pressure will be allowed during the last two hours of the pressure test.

2. Water services, including corporation and curb stops, will be tested. The Contractor may choose to include services at the time of watermain testing or as a separate operation at a reduced pressure of 100 PSIG. If performed separately, testing will be done with the corporation stops open.

B. Disinfection

1. Disinfect and complete bacteriological testing on all temporary and permanent water distribution systems in accordance with the provisions of AWWA C651.

******END OF SECTION******

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SECTION 33 31 00 - SANITARY SEWERAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to sanitary sewer and service lateral construction as indicated on the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section will be included in the Lump Sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. The following referenced Specifications will apply to this Section:

1. ASTM D2321
2. ASTM D3034
3. ASTM F679
4. ASTM D1784
5. ASTM D543
6. ASTM D1248
7. ASTM D3350
8. AWWA C900
9. AWWA C-906
10. CEAM 2621
11. MnDOT 2506

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. A sanitary sewer bypass pumping plan and traffic control plan will be submitted to the Engineer for review a minimum of 5 working days prior to beginning of work.

1. The bypass pump system will be of sufficient capacity to handle existing flow at peak flow times.

B. Work plan for temporary service.

C. Sanitary Sewer and Sanitary Sewer Service

1. Manhole structure - shop drawings.
2. Manhole casting - shop drawings.
3. Piping and fittings - Certificates of Compliance.

D. Final post-construction televised inspection report and video files.

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PART 2 - PRODUCTS

2.1 OPEN CUT SEWER PIPE AND FITTINGS

A. All pipe and fittings must be laid on a continuous granular bed. Installation must comply with ASTM D2321

B. Solid Wall Polyvinyl Chloride (PVC) Pipe

1. 4.0-inch through 6.0-inch Diameters: Smooth-walled polyvinyl chloride pipe and fittings shall conform with the requirements of the Standard Dimension Ratio (SDR) of 26, unless otherwise specified on the plans.

2. 8.0-inch through 15-inch Diameters: Smooth-walled polyvinyl chloride pipe and fittings shall conform with the requirements of ASTM D3034 for the Standard Dimension Ratio (SDR) of 35, for depths of less than 20.0-feet, unless otherwise specified on the plans. The SDR for depths exceeding 20.0-feet shall be 26, unless otherwise specified on the plans.

3. Over 15" Diameters: Smooth-walled polyvinyl chloride pipe and fittings shall conform with the requirements of ASTM F679 with a minimum wall thickness for a minimum pipe stiffness of 46, for depths less than 20.0-feet unless otherwise specified in the plans. A minimum SDR of 26 shall be used for depths exceeding 20.0-feet, unless, unless otherwise specified on the plans.

4. WYES: All wyes shall be heavy wall and shall conform with the requirements of ASTM D3034 for the Standard Dimension Ratio (SDR) of 26, unless otherwise specified on the plans.

5. The connection shall be push-on with elastomeric gasketed joints, which are bonded to the inner walls of the gasket recess of the bell socket.

6. The pipe grade used shall be resistant to aggressive soil and corrosive substances in accordance with the requirements of ASTM D543.

2.2 MANHOLES

A. Precast Concrete Manholes

1. Sanitary sewer manholes will conform to the MnDOT Standard Plate No. 4007C, unless otherwise shown on the plans, including integral base sections and rubber gasketed tongue and groove joints. All pipe openings will have an integral cast watertight seal.

2. Reinforced polypropylene plastic steps will be furnished for all sanitary sewer manholes eight or more feet in depth.

B. Inside Drop Manhole

1. Inside drops shall be IntraFlow Inside Drop Structure or approved equal.

C. Castings

1. The type of casting assembly to be used will be Neenah R-1733 solid lid with two concealed pick holes, 2.0-inch raised letters stamped “SANITARY SEWER” and a self-sealing lid. The frame will be Neenah R-1733.

2. All casting assemblies will meet the certification requirements of the Minnesota Department of Transportation and be manufactured by a MnDOT approved source.

D. Chimney Seal

1. Chimney seal will be I&I Barrier as manufactured by Strike Tool Company, Alignment Barrier as manufactured by Ess Brothers, or approved equal.

(a) The chimney seal will be sealed to the manhole cone section using Infi-Shield External Gator Wrap. The wrap will be placed on the exterior extending a minimum of 3.0-inches onto the cone section. The barrier will extend up into the manhole casting to a point approximately 2.0-inches below the manhole cover.

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(b) Manhole Barrel Joints

(1) Exterior manhole joint wrap will be Infi-Shield External Gator Wrap.

E. Adjusting Rings

1. Only Ladtech H.D.P.E adjusting rings or approved equal, with approved mastic, shall be permitted for new manhole installations and for manhole chimney repairs.

(a) If necessary to fit with the chimney seal, the Contractor may cut the tab off the bottom ring.

(b) The chimney seal shall be sealed to the manhole cone section using Infi-Shield External Gator Wrap. The wrap shall be placed on the exterior extending a minimum of 3.0-inches onto the cone section. The barrier shall extend up into the manhole casting to a point approximately 2.0-inches below the manhole cover.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE AND FITTINGS

A. Sanitary Main Installation

1. No exception to the referenced specification is made.

B. Sewer Service Installation

1. The Contractor shall imprint the concrete face of the curb at the locations of the utility service locations in accordance with City standards.

2. The Contractor shall dye water test all existing sanitary sewer service line connections cut, severed, or encountered during the construction to determine whether they are still active. Those service lines which are no longer in use will be abandoned by plugging the severed upstream end with a suitable watertight plug approved by the Engineer.

3. The Contractor shall keep accurate records as to the location of the service connections, manholes, cleanouts, wyes, bends, risers, and connections to existing structures, pipes, and stub outs as constructed. Measurements to the service line will be taken from the two nearest permanent structures (i.e., hydrants, valves, manholes, buildings) as directed by the Engineer. Final payment for the project will not be made until the information is in the possession of the Owner.

4. The Contractor shall install new service pipe from the wye branch to the property line, as shown on the plans.

5. The Contractor shall imprint the concrete face of the curb at the locations of the utility service locations in accordance with City standards.

3.2 MANHOLE STRUCTURE

A. Connect to Existing Sanitary Sewer

1. When connection to an existing sanitary sewer is made at an existing or proposed manhole, the Contractor shall expose and verify the elevation of the existing sewer prior to laying any sanitary sewer to, or from, the connection point. If the elevation of the existing sewer does not match the elevation shown on the plans, the Contractor shall notify the Engineer, at which time the Engineer may adjust the proposed grades.

2. Connections to existing sanitary sewers will be rigid and watertight.

3. Connections to existing structures will be watertight. The installation of Cor-N-Seal boots, or equal, will be required.

B. Raise / Lower Existing Manhole

1. Raising and/or lowering an existing manhole to meet a proposed finished rim elevation is performed when the addition and/or deletion of 2.0-inch adjusting rings will not reach a minimum of 2 rings or

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exceed a maximum of 6 rings. Typically, it will require: the removal of the manhole cone section or the concrete slab top; the addition, removal, or exchange of barrel sections; the replacement of the cone section or the concrete slab top; the installation of the proper number of adjusting rings; and the replacement of the manhole casting and frame. In some cases, the existing structure may require saw cutting.

C. Manhole Base

1. Pre-cast bases will be used for all manholes.
2. Integral cast base is required unless otherwise shown on the plans or approved by the Engineer.
3. Manholes will be set on a minimum of 6.0-inches of compacted foundation material.

D. Miscellaneous Work

1. If concrete adjusting rings are used, they will be set with bituminous mastic or cement mortar and will be plastered inside and out, with a minimum thickness of ½-inch of mortar. A maximum of 3 individual adjusting rings will be used. Taller 6.0-inch or 12.0-inch rings will be used where adjustment requires more than three 2.0-inch rings.
2. If HDPE adjusting rings are permitted in Part 2 and used, the sealant material and method will be in accordance with the manufacturer's recommendations.

E. Utility Location System

1. The Contractor shall install the underground utility location system (tracer wire) with all sanitary sewer and services in accordance with Appendix D – Sewer/Water Utility – Trace Wire Specification of this Project Manual.

3.3 FIELD QUALITY CONTROL

A. Deflection test

1. No exception to the referenced specification is made.

B. Sanitary sewer leakage testing

Leakage tests will be conducted as described in the referenced specification. However, leakage testing will not be necessary where existing services are connected directly to the new sewer as it is being constructed.

1. Air Testing

(a) No exception to the referenced specification is made.

2. Hydrostatic Testing

(a) Hydrostatic testing will not be allowed on this project.

C. Cleaning and Televising

1. Cleaning and Televising are required after the installation and backfill are complete and prior to the placement of roadway aggregate base or pavement.
2. Reference Section 33 01 30.12 "Cleaning and Television Inspection of Sewers" of this Project Manual for cleaning and televising requirements.

******END OF SECTION******

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SECTION 33 31 23 - SANITARY SEWERAGE FORCE MAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment, and performances of all work and services necessary or incidental to force main construction as indicated on the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Measurement and compensation for the following items will be paid according to the referenced specification or as modified below:

1. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The furnishing and installing of specific items and/or the performance of work under certain circumstances will not be individually paid in the absence of a specific bid item for the work. The costs will be included in the unit price bid for the force main items, as indicated. Such items of work include but are not limited to:

1. Furnishing and installing all bends, pipe restraints, blocking, and fittings will be included in the price bid for the force main.
2. Furnishing and installing the underground utility location system will be included in the price bid for the force main.
3. The furnishing and installing polyethylene encasement material will be included in the price bid for the force main.
4. Concrete blocking or metal ties will be included in the price bid for the force main.
5. Hydrostatic, leakage, and continuity testing will be included in the price bid for force main.
6. Delays due to other utility conflicts which result during construction will be included in the price bid for force main.
7. Protecting existing improvements from damage will be included in the price bid for force main.
8. Connecting to existing structures will be included in the price bid for force main.
9. Valve operating nut extension rod(s) will be included in the unit price bid for valves.
10. If the force main is to be installed inside a casing pipe, furnishing and placing the carrier pipe, carrier pipe support materials, sand fill, and grout seals will be included in the unit price bid for force main.

1.3 SPECIFICATION REFERENCES

A. Reference the following Sections of this Project Manual as appropriate:

1. ASTM D1248
2. ASTM D1784
3. ASTM D2241
4. ASTM D2513
5. ASTM D3139
6. ASTM D3261
7. ASTM F477

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8. AWWA C900
9. AWWA C906
10. CEAM 2621

B. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

1.4 SUBMITTALS

A. Manhole structure - shop drawings.

B. Manhole casting - shop drawings.

C. Piping and fittings - Certificates of Compliance.

D. Valves – shop drawings and Certificates of Compliance.

PART 2 - PRODUCTS

2.1 OPEN CUT FORCE MAIN PIPE AND FITTING MATERIALS

A. Pressure Polyvinyl Chloride (PVC) Pipe

1. Force main pipe material will be polyvinyl chloride (PVC) pipe having a cell classification of 12454.B as defined in ASTM Designation D1784. The dimensions, physical requirements, test methods, and extrusion quality will meet the requirements of ASTM D2241 for dimension ratio (SDR) of 26, pressure Class 160, and will have IPS outside diameter. Gasketed integral bells will conform to ASTM D3139 "Standard Specification for Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals." Gaskets will conform to ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joint Plastic Pipe."

B. C900 Polyvinyl Chloride (PVC) Pipe

1. The force main pipe material will be polyvinyl chloride (PVC) pressure pipe conforming to the current requirements of AWWA C900 (DR 18) for pipe diameters 4.0-inch through 12.0-inch or AWWA C905 (DR 25) for pipe diameters 14.0-inch through 24.0-inch. The pipe will be manufactured in cast iron outside diameters and will have an integral bell and spigot with an elastomeric gasket conforming to ASTM D3139. The pipe and components will meet the requirements of ANSI/NSF 61 for the conveyance of potable water.

C. Pressure Pipe Joint Restraint Clamps

1. The clamps (Series 6500 Ebaa Iron, Inc.) will be ductile iron and supplied with a sufficient number of ductile iron bolts to restrain working and test pressures for this application.

D. Pipe Fitting Materials

1. The following pressure pipe fitting materials will be allowed for use on this project:
2. Mechanical Class 350 ductile iron fittings will be used.
3. All fittings will be coated with a 6-8 mil nominal thickness fusion bonded epoxy conforming to the requirements of ANSI/AWWA C550 and C116/A21.
4. All fittings, valves, hydrants, and restraining rods will be protected by using sacrificial zinc anode caps, ASTM B418 6 oz. Large Zinc Anode Caps as manufactured by Trumbull Industries Inc., or an approved equal. Contractors shall supply 2 anode caps per mechanical joint gland installed.
5. All fittings, valves, hydrants, etc., will be secured utilizing COR-BLUE T-BOLTS as manufactured by NSS Industries or approved equal.
6. All Restraining devices (megalugs) will be coated with a 6-8 mil nominal thickness, fusion bonded epoxy conforming to the requirements of ANSI/ AWWA C550 and C116/A21.

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7. Adaptors, backup rings, and oversize sleeves will be provided for transitions and connections to dissimilar types of pipe materials. All sleeve fittings will be long mechanical joints.

8. All fittings will have been manufactured in the year of construction or prior calendar year.

9. Quality control of all fitting manufacturers will conform to the requirements of the International Organization for Standardization (ISO).

2.2 TRENCHLESS PIPE MATERIAL & STRUCTURAL REQUIREMENTS

A. All pipes will be made from virgin material. No rework except that obtained from the manufacturer's production of the same formulation will be used.

B. The pipe will be homogenous throughout and will be free of visible cracks, holes, foreign material, blisters, and/or other deleterious faults.

C. Any section of pipe with a gash, blister, abrasion, nick scar, or other deleterious faults greater than 10 percent of the wall thickness, will not be used and must be removed from the site. However, a defective portion of the pipe, as defined above, may be cut out and butt-fused in accordance with the procedures herein.

D. Any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness, or any other defect of manufacturing and/or handling will not be used and will be removed from the site.

E. Internal Pipe Diameters

1. The actual inside barrel diameter of the pipe used for pressure pipe will not be less than that of DIP, Class 52 for the corresponding nominal pipe size.

F. Forcemain Applications

1. Fusible C900

(a) As manufactured by Underground Solutions (www.undergroundsolutions.com). ASTM D1784. with cell classification 12454. The formulation for extrusion of Fusible C900 will be compounded to the specific proprietary recipe for Fusible pipe and meet the requirements of PPI TR-2.

(b) Butt joint fused PVC pressure pipe conforming to AWWA C900 for 150 psi pressure rating (SDR 18). However, a structurally stronger pipe may be required to ensure resistance to pulling stresses.

(c) Pipe fusing will meet manufacturer requirements.

(d) A manufacturer's representative will be present during fusing and installation.

2. Restrained Joint DIP Pipe and Fittings

(a) Flex-Ring Joint Pipe (DIP), as manufactured by American Ductile Iron Pipe or equal. The pipe will be a pressure pipe with a 350 psi working pressure for diameters up to and including 12.0-inch, and 250 psi for diameters 14.0-inch to and including 20.0-inch. Structurally stronger pipe may be needed to ensure resistance to damaging stresses relative to the trenchless construction technique.

(b) Joints will be Flex-Ring Restrained Joint couplings as manufactured by American Ductile Iron Pipe or equal.

2.3 ADJUSTING RINGS

A. Only Ladtech H.D.P.E adjusting rings or approved equal, with approved mastic, will be permitted for new manhole installations and manhole chimney repairs.

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1. Adjusting rings will be completely encased in Infi-Shield Gator Wrap. The wrap will be installed per the manufacturer's recommendations and will extend a minimum of 3.0-inches past the adjusting rings onto the drainage structure and casting to create a water-tight seal.

2.4 POLYETHYLENE ENCASEMENT

A. No exception to the referenced specification is made.

2.5 VALVE AND VALVE HOUSING

A. All valves will have been manufactured in the year of construction or prior calendar year.

B. Valve Housing

1. Cast-iron screw-type valve boxes will be installed where indicated on underground valves. The cast-iron valve boxes will be of either the two-piece or three-piece style and will be furnished with a stay-put cover with raised letters indicating "SEWER." The shaft will be 5¼-inch inside diameter.

2. All valve box assemblies will be furnished with a valve umbrella anchorage assembly. The valve umbrella anchorage will be manufactured by Adaptor, Inc., Oak Creek, WI, or equal.

C. Gate Valves

1. All valves to be furnished and installed on the main will be AWWA C-509-<current edition>, non-rising stem, iron body, resilient-sealed gate valves, with 2.0-inch square opening nut rated for a 200 psi working pressure. These valves will be Waterous or approved equal. All valves will open 'left'.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE AND FITTINGS

A. Blocking and Anchoring of Pipe

1. A thrust block of cast-in-place concrete, which covers the installed fitting, is not permitted. Pre-cast concrete thrust blocks and other restraining devices such as restrained joint retainer glands will be provided at all bends or wherever the force main changes direction, valves will be tied to the nearest force main fitting.

B. Polystyrene Insulation

1. The Contractor shall install polystyrene insulation in those areas where the force main may be susceptible to frost or freezing, or as directed by the Engineer.

C. Polyethylene Encasement

1. The Contractor shall furnish and install polyethylene encasement for the entire main and all appurtenances in accordance with the referenced specification.

3.2 FIELD QUALITY CONTROL

A. No exception to the referenced Specification is made unless a non-conductive force main is installed, in which case the conductivity requirements, as specified are deleted.

B. The Engineer may require the Contractor to demonstrate that the force main meets the requirements of CEAM 2621 for pipe deflection.

C. The Engineer may require the Contractor to perform a hydrostatic pressure test as specified in CEAM 2611 to a pressure of 100 psi.

******END OF SECTION******

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SECTION 33 42 00 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the furnishing of all labor, materials, tools, equipment and performances of all work and services necessary or incidental to storm sewer construction as indicated on the drawings or as specified herein.

1.2 METHOD OF MEASUREMENT AND PAYMENT

A. Payment for all labor, equipment, materials, and supplies necessary to complete the work specified in this section shall be included in the lump sum bid for the project or appropriate bidding section.

B. The Contractor shall not perform work that the Contractor considers Extra Work without the written approval of the Engineer.

1.3 SPECIFICATION REFERENCES

A. The following Sections of this Project Manual as listed:

1. Section 33 05 06 “Trenching and Backfilling”.

2. Section 33 05 07 “Trenchless Installation of Utility Piping”.

B. ASTM D543 shall apply, except as modified herein.

C. ASTM D1248 shall apply, except as modified herein.

D. ASTM D1784 shall apply, except as modified herein.

E. ASTM D3034 shall apply, except as modified herein.

F. ASTM D3213 shall apply, except as modified herein.

G. ASTM D3261 shall apply, except as modified herein.

H. ASTM D3350 shall apply, except as modified herein.

I. ASTM F679 shall apply, except as modified herein.

J. ASTM F949 shall apply, except as modified herein.

K. AWWA C900 shall apply, except as modified herein.

L. AWWA C906 shall apply, except as modified herein.

M. CEAM 2621 shall apply, except as modified herein.

N. MnDOT 2503 shall apply, except as modified herein.

O. MnDOT 2506 shall apply, except as modified herein.

P. MnDOT 3236 shall apply, except as modified herein.

Q. MnDOT 3245 shall apply, except as modified herein.

R. MnDOT 3733 shall apply, except as modified herein.

S. MnDOT Standard Plates Manual with latest revisions.

T. State of Minnesota Plumbing Code shall apply to all underground pipe sewers installed through areas to be occupied by buildings. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

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1.4 SUBMITTALS

A. Storm Sewer

1. Manhole and catch basin structure - shop drawings.
2. Manhole and catch basin casting - shop drawings.
3. Piping and fittings - Certificates of Compliance.

PART 2 - PRODUCTS

2.1 OPEN CUT SEWER PIPE AND FITTINGS

A. Reinforced Concrete Pipe (MnDOT 3236)

1. All joints shall be rubber gasketed conforming to MnDOT Standard Plate 3006.
2. Unless otherwise specified on the plans, in the plan details, or in the Schedule of Unit Prices:
3. The pipe shall be bedded in Class C Bedding. The class of pipe shall conform to the following table for 120 pounds per cubic foot (PCF) soil. If field conditions are beyond the conditions presented in the table or vary from the assumptions stipulated above, the Contractor shall make a request to the Engineer for direction.

Pipe Dia. (inches)	**Maximum Overfill Above Pipe (Feet)**		
	Soil - Granular 120 pcf		
Class	**III**	**IV**	**V**
12	10	13	100
15	8	16	100
18	9	19	100
21	10	21	100
24	10	23	100
27	11	24	100
30	11	24	100
33	12	25	100
36	12	25	100
42	12	23	100
48	12	21	62
54	11	20	45
60	11	19	39
66	11	19	39
72	12	20	39
78	12	20	38
84	12	20	38

4. Joints and Fittings:

(a) Watertight joints shall be bell-and-spigot meeting the watertight requirements of ASTM F2736 or ASTM F2881. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

(b) Fittings: Fittings shall conform to ASTM F2736 or ASTM F2764. Joint shall meet watertight joint performance requirements of ASTM D3212. Bell & spigot connections shall utilize a spun-on, welded or integral bell and spigot with gaskets meeting ASTM F477.

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B. The Contractor shall verify the lengths of conduit necessary in the field before fabrication.

2.2 MANHOLES & CATCH BASINS

A. Precast Concrete Manholes and Catch Basin Section

1. Storm sewer manholes shall conform to the MnDOT Standard for the design type shown on the plans.

2. Reinforced polypropylene plastic steps shall be furnished for all storm sewer manholes 8.0-feet or more in depth.

B. Castings

1. All casting assemblies shall meet the certification requirements of the Minnesota Department of Transportation and be manufactured by a MnDOT approved source.

2. The type of casting assembly to be used shall be Neenah R-1733 solid lid with two open lift holes and 2.0-inch raised letters stamped “STORM SEWER”. The frame shall be Neenah R-1733.

3. The type of curb and gutter catch basin casting assembly to be used shall be Neenah R-3067-L, unless otherwise specified on the plan.

C. Adjusting Rings

1. Only Ladtech H.D.P.E adjusting rings or approved equal, with approved mastic, will be permitted for new manhole installations and manhole chimney repairs.

(a) Adjusting rings will be completely encased in Infi-Shield Gator Wrap. The wrap will be installed per the manufacturer’s recommendations and will extend a minimum of 3.0-inches past the adjusting rings onto the drainage structure and casting to create a water-tight seal.

D. Chimney Seal

1. External storm sewer chimney seals shall consist of Infi-Shield Gator Wrap as manufactured by Sealing Systems, Inc., or equal.

2. Adjusting rings shall be completely encased in Infi-Shield Gator Wrap. The wrap shall be installed per the manufacturer’s recommendations and shall extend a minimum of 3.0_inches past the adjusting rings onto the drainage structure and casting to create a water-tight seal.

2.3 GEOTEXTILE FABRIC

A. MnDOT 3733, Type I, non-woven for use in wrapping joints in storm sewer.

PART 3 - EXECUTION

3.1 MANHOLE AND CATCH BASIN STRUCTURES

A. Raise / Lower Existing Structure

1. Raising and/or lowering an existing manhole to meet a proposed finished rim elevation is performed when the addition and/or deletion of 2.0-inch adjusting rings will not reach a minimum of 2 rings or exceed a maximum of 6 rings. Typically, it will require: the removal of the manhole cone section or the concrete slab top; the addition, removal, or exchange of barrel sections; the replacement of the cone section or the concrete slab top; the installation of the proper number of adjusting rings; and the replacement of the manhole casting and frame.

B. Miscellaneous Work

1. If concrete adjusting rings are used, plaster all manhole adjusting rings installed inside and out, with a minimum thickness of ½-inch of mortar. A maximum of 3 individual adjusting rings shall be used. Taller 6.0-inch or 12.0-inch rings shall be used where adjustment requires more than three 2.0-inch rings.

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2. If HDPE adjusting rings are used, the sealant material and method shall be in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. Deflection test - No exception to the referenced specification is made.

B. Cleaning and Televising

1. Cleaning and Televising are required after the installation and backfill are complete and prior to the placement of roadway aggregate base or pavement.

2. Reference Section 33 01 30.12 “Cleaning and Televising Inspection of Sewers” for cleaning and televising requirements.

******END OF SECTION******

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SECTION 40 05 57 - ELECTRIC VALVE ACTUATORS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install the following valve operators, complete and operable, including all controls, motors, gears, etc., as shown and as specified herein, in accordance with the requirements of the Contract Documents. Completed assembly shall bear a UL label or other third-party label accepted by the Minnesota State Board of Electricity.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 90 02 - Instrumentation and Control

B. Section 40 05 59 - Hydraulic Gates

C. Section 40 05 60 - Valves

1.3 QUALITY ASSURANCE

A. For all the electric motor operators, the CONTRACTOR shall assign the instrumentation and controls supplier the responsibility of field adjustments to set the operator limit switches and potentiometers for the required function. The CONTRACTOR shall furnish and install the valve and the operator. All wires of motor operators shall be identified with a unique number.

PART 2 -- PRODUCTS

2.1 ELECTRIC MOTOR OPERATORS (AC REVERSING CONTROL TYPE)

A. **Equipment Requirements:** Where electric motor operators are indicated in the valve schedule or drawings, an electric motor-operated valve control unit shall be attached to the valve operating mechanism housing by means of a flanged motor adaptor piece. The electric actuator shall include integral reversing controls, double reduction gearing, removable valve-stem drive nut/bushing, mechanically coupled position and torque overload limits, ductile iron gear case, and automatic declutching hand crank. The mechanical actuator design shall have a minimum of 10 years of proven dependable service. All electric actuators must comply with AWWA C540.

B. **Gearing:** The motor operator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weatherproof NEMA IV assembly. The operator shall be a double reduction unit consisting of spur or helical gears and worm gearing. The spur or helical gears shall be of hardened alloy steel, and the worm gear shall be alloy bronze. All power gearing shall be grease or oil lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Operator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gear set ratio without further disassembly of the electric operator.

C. **Rotating Components:** All power transmission gearing and shafting shall be supported on easily replaceable cartridge-type antifriction bearings. For thrust applications, the output drive sleeve shall be supported on tapered roller bearings. The internal power transmission shaft and gear connections shall use splined connections for equal load distribution. Internal keyed power transmission connections are not acceptable.

D. **Starting Device:** The unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The operator motor must attain full speed before stem load is encountered.

E. **Switches and Wiring:** Travel in the opening and closing directions shall be governed by a switch responsive to mechanical torque developed in seating the valve or by an obstruction met in opening or closing the valve. The torque switch shall be adjustable and function without auxiliary relays or devices. The geared limit switches shall be of the open type and shall be actuated by a rotor cam with 4 contacts to each cam or gear train. The operator shall have a number of gear trains as required to produce the operation shown. The operator shall be wired in accordance with the schematic diagram, and all wiring for external connections shall be connected to marked terminals. One 1-inch and one 1-1/4-inch conduit connection shall be provided in the enclosing case.

F. **Handwheel Operation:** A permanently-attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Microswitch elements or devices relying on coil springs shall not be used in the torque switches. Position limit switches and associated gearing shall be an integral part of the valve operator. To provide the best possible accuracy and repeatability, limit switch gearing shall be of the "counting" intermittent type, made of stainless steel, grease lubricated, and enclosed in its own gear case to prevent dirt and foreign matter from entering the gear train. Switches shall not be subject to breakage or slippage due to overtravel. Traveling nuts, cams, or micro switch tripping mechanisms shall not be used. Limit switches shall be of the heavy-duty open contact type with rotary wiping action. The maximum torque required on the handwheel under the most adverse conditions specified herein shall not exceed 60 lb.-ft., and the maximum force required on the rim of the handwheel shall not exceed 60 lb. An arrow and either the word "open" or "close" shall be cast on the handwheel to indicate the direction to turn said handwheel.

G. **Lubrication:** All power transmission gears and bearings shall be oil or grease bath lubricated and suitable for year-round service based on prevailing ambient temperature conditions of -40 ºF to 160 ºF (-40 ºC to 70 ºC).

H. **Torque Limits:** The actuator shall include adjustable open and close torque limits to interrupt the motor power circuit if valve forces become excessive, an obstruction is encountered, or torque seating is required for tight shut-off. Torque limits shall be adjustable in 5% increments between 15% and 100% of the actuator rating. Torque output shall be constantly displayed by a bar graph on the Local Display Module (LDM) during motor and manual operation. Mechanical torque springs shall be field-replaceable without removing the motor or the worm, thus allowing the actuator's torque output range to be field modified when required.

I. **Position Limits**: shall be mechanically geared to the drive mechanism and in step with valve position in both motor and manual operation. The actuator shall use an Absolute Position Detector (APD) to continuously monitor valve position, even during a power failure. Batteries shall not be required to maintain APD limit settings. Position limits shall not require resetting if the actuator is manually operated during a power failure. Position limit contacts shall be rated 5 amps at 250 volts AC and 5 amps at 30 volts DC. A minimum of four (4) contacts, user-configurable as N.O. or N.C., shall be provided for reporting valve position. Open and close limit switches shall be provided as standard equipment

J. **Motor:** The motor shall be of the totally enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 120-volt, single-phase, 60-Hz current, have Class B insulation, and a motor frame with all dimensions in accordance with the latest revised NEMA Standards. The observed temperature rise by thermometer shall not exceed 55 ºC

above an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With a line voltage of not more than 10 percent above or 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices embedded in the motor windings to trip or the starter overloads to drop out. All bearings shall be of the ball type, and thrust bearings shall be provided where necessary. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate using the stator and rotor as independent components from the valve operation such that the failure of either item shall not require operator disassembly or gearing replacement. The motor shall be furnished with a space heater suitable for operation on a 120-volt single-phase circuit. The motor shall be capable of 1200 starts per hour and an expected lifetime of 20,000 hours at 150 starts per hour.

K. **Position Indication** shall be in step with valve position during electric and manual operation. The valve position shall be continuously displayed on the liquid crystal display (LCD) in 1% increments from 0 to 100%. An optional Display Backup Module (DBM) shall be provided to power the LDM if primary power is lost. A 4-20mA position feedback signal shall also be provided. All part-turn actuators shall have a mechanical dial indicator on the top of the output drive sleeve.

L. **Control Compartment** shall include, as a minimum, a thermostatically controlled space heater, position and torque limits, and reversing controls, all housed in a control compartment that complies with NEMA 4/IP67 (Weatherproof) OR NEMA 7 (Explosion-proof) in all classified areas. Provide motor overload relays within the controls compartment to detect overcurrent in each phase. The overload relay shall be auto-resetting.

M. **Operator Appurtenances:** The operator for each valve shall include open and close limit switches, 2 indication lights, 3 pushbuttons for open-stop-close, and a local-remote selector switch. The valve operator shall also include a 1000 ohm sealed feedback potentiometer for valve position feedback for control as described in Section 26 90 02 - Instrumentation and Control.

N. **Reversing Controls** shall include electrically and mechanically interlocked reversing contactors and control power transformers. An automatic phase correction and phase detection (loss of phase) device shall be provided. Remote operation shall be possible using two, three, or four-wire control and shall be powered internally from the actuator's 24 VDC.

O. **Separate Terminal Chamber** (STC) The actuator shall be furnished with a separate terminal chamber with a 48-point terminal strip for all field-wiring connections. The terminal strip shall accommodate the installation of bare wire(s) or crimped terminal connectors. Terminal strip screws shall be pre-inserted and shall be made of nickel-plated brass. Control power primary fuses must be located within the STC for ease of replacement. Fuse replacement shall not require the removal of any other sealed control compartment cover. Secondary control circuit protection shall use auto-resetting devices. Terminal strip markings shall be highly visible and not require separate terminal identification cards. For easy access, the termination cover shall be threaded and provided with a locking grub screw. The separate terminal chamber shall be provided with four (4) NPT conduit entries – (3) 1 inch and (1) 1 ½ inch.

P. **Local Display Module** (LDM) shall use a Liquid Crystal display module to simultaneously display the mode of operation, actuator status, valve position, and torque and alarm conditions. The display shall have a 32 full-character alphanumeric message center for displaying actuator setup selections and data entry feedback.

Q. **Discrete Outputs** The actuator shall have as standard five (5) relay outputs, configurable as N.O. or N.C., of which four (4) can be configured to be active for listed alarms/conditions. The fifth relay output is configured as a monitor relay, non-latching, with (1) N.O. and (1) N.C. contact. For discrete

controlled actuators, an optional auxiliary relay module (ARM) can provide four (additional) user-configurable relay outputs.

R. **Electronics Fault Monitor** shall provide independent circuits to ensure safe operation or shut down of the motor control circuits to protect the actuator and the valve. The EFM monitors all internal modules and shuts down the actuator if an unsafe condition is detected. The EFM shall use independent electronic circuits and not rely on microprocessors or software programming.

S. **Analog Control** The analog comparator circuit shall use a solid-state, plug-in PC board that will accept a 4-20mA input control signal from a remote position controller. The circuit shall provide one (1) 4-20 mA output signal for remote position indication and one (1) 4-20 mA output signal for remote torque indication. The system shall provide zero, span, band, and delay adjustments. Input and output signals shall be optically isolated. Set-up adjustments shall allow remain-in-last position or travel to preset position upon loss of control signal. The actuator shall be configurable for standard or reverse signal operation (4 mA = open and 20 mA = close).

1. Modulation service shall provide up to 1200 starts per hour for 3-phase power. Solid-state reversing starters shall be used. Required position accuracy shall not exceed +/-0.5%.

T. Manufacturers, or Equal:

1. AUMA
2. EIM
3. Rotork

2.2 PORTABLE VALVE ACTUATORS

A. Provide one (1) portable valve actuator suitable for manual hydraulic gates. Coordinate torque requirements with gate supplier.

B. Torque Limits: 850 NM maximum torque with integrated electronic torque limiter.

C. Power: 18V Lithium-Ion batteries. Provide a minimum of four (4) batteries and one (1) 240-volt charging station.

D. Manufacturers, or Equal:

1. Modec, Model MC89S-054

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The valve and the operator shall be installed as per manufacturer’s recommendation.

B. The instrumentation and controls supplier shall calibrate valve components and make limit switch settings.

**** END OF SECTION ****

SECTION 40 05 59 - HYDRAULIC GATES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all tools, supplies, materials, equipment, and labor necessary for the installation, testing, and placing into operation of all hydraulic gates with appurtenances, complete and operable, in accordance with the requirements of the Contract Documents.

B. The CONTRACTOR shall assign to a single manufacturer full responsibility for the furnishing and functional operation of the hydraulic gates including operators and accessories. The designated single manufacturer, however, need not manufacture more than one part of the unit(s) but shall coordinate the design, assembly, testing, and erection of the unit(s) as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 43 00 00 - Equipment General Provisions

B. Section 40 05 57 - Electric Valve Actuators

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

AWWA C561	Fabricated Stainless Steel Slide Gates
AWWA C562	Fabricated Aluminum Slide Gates
AWWA C563	Fabricated Composite Slide Gates
ASTM A 240	Specifications for Stainless
ASTM A 276	Specifications for Stainless and Heat-Resisting Steel Bars and Shapes.
ASTM B 21	Specification for Naval Brass Rod, Bar, and Shapes.
ASTM B 584	Specification for Copper Alloy Sand Castings for General Applications.

1.4 CONTRACTOR SUBMITTALS

A. Shop Drawings: Shop drawings of all hydraulic gates and valves shall be submitted to the ENGINEER in accordance with Section 01 33 00, “Submittals”.

B. O & M Manuals: Prior to start-up the CONTRACTOR shall furnish to the OWNER complete operations and maintenance manuals in accordance with Section 01 33 00, “Contractor Submittals”.

C. Tools: Special tools necessary for maintenance and repair of the hydraulic gates and valves shall be furnished as a part of the WORK hereunder; such tools shall be suitably stored in metal toolboxes, and identified with the equipment number by means of solid plastic name tags attached to the box.

D. Spare Parts: The CONTRACTOR shall obtain from the manufacturer a list of suggested spare parts of all items subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, etc. He shall furnish all these parts suitably packaged and labeled in a box as described above for tools.

E. Maintenance: Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units. A recommended spare parts list shall be included.

F. Field Procedures: Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of the gates and valves.

1.5 QUALITY ASSURANCE

A. Equipment Testing: The CONTRACTOR shall be responsible for the coordination of the test of each hydraulic gate and valve with operators, in the presence of the manufacturer's factory service representative. Any excessive leaks shall be corrected, and the equipment retested until found satisfactory.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS OR EQUAL

A. Fontaine-Aquanox

B. Rodney Hunt

C. Whipps

D. RW Gate

2.2 SLUICE GATES

A. **General:** All the sluice gates shall be of stainless steel construction and shall meet or exceed AWWA C513 standards. Each sluice gate shall be downward acting, rising stem type unless called out otherwise on the plans.

B. **Frame:** The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be of the flange back design, suitable for mounting on a concrete wall. The guide slot shall be made of UHMWPE (ultra-high molecular weight polyethylene).

C. **Slide:** The slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate’s span under the design head.

D. **Guides and Seals:** The guides shall be made of UHMWPE (ultra-high molecular weight polyethylene) and shall be of such length as to retain and support at least two-thirds (2/3) of the vertical height of the slides in the fully open position. The bottom and side seals shall be made of UHMWPE (ultra-high molecular weight polyethylene) of the self-adjusting type. A continuous compression cord shall ensure contact between the UHMWPE guide and the gate in all positions. The sealing system shall maintain efficient sealing in any position of the slide and let the water flow in the open part of the gate.

E. **Stem and Couplings:** The operating stem shall be of stainless steel designed to transmit in compression at least two (2) times the rated output of the operating manual mechanism with a 40 lbs. effort on the handwheel. Gates having a width equal to or greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.

F. **Stem Guides:** Stem guides shall be fabricated from type 304L stainless steel. The guide shall be equipped with a UHMWPE bushing. Guides shall be adjustable and shall be spaced in accordance with the manufacturer’s recommendation. The L/R ratio shall not be greater than 200.

G. **Stem Cover:** Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents as well as a clear Mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

H. **Lifting Mechanism:** All bearings and gears shall be totally enclosed in weather-tight housing. The pinion shaft of crank-operated mechanisms shall be constructed of stainless steel and supported by roller or needle bearings. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lbs on the handwheel and shall be able to withstand, without damage, an effort of 80 lbs. Lifting mechanism shall be compatible with the portable electric actuator specified in Section 40 05 57.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Hydraulic gates shall be installed in accordance with procedures submitted with the CONTRACTOR approved shop drawings and as shown, unless otherwise acceptable to the ENGINEER.

B. **Alignment**: Equipment shall be field-tested to verify proper alignment, operation as specified, and freedom from binding, scraping, or other defects. Equipment shall be secure in position and neat in appearance. Operators shall be located to avoid interference with handrails and structural members.

C. **Lubricants:** The installation work shall include furnishing the necessary oil and grease for initial operation.

3.2 PAINTING

A. All exposed materials, except corrosion-resistant metals which have not been shop-coated, shall be field coated as specified in Section 09 91 00 “Painting”. Shop coated items that suffer damage to the shop coating shall be touched up as specified in Section 09 91 00 “Painting”.

B. All aluminum in contact with concrete shall be shop coated with coal tar epoxy as specified in Section 09 91 00 “Painting”.

**** END OF SECTION ****

SECTION 40 05 60 - VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, epoxy coating, installing, adjusting, and testing all valves and appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents. Where buried valves are shown, the CONTRACTOR shall furnish and install valve boxes to grade, with covers, extensions, and position indicators. Valves located six feet or higher above operating floors shall be provided with enclosed chain wheel gear-type actuators and chains. The chain shall extend to a point four feet above the operating floor.

B. All valves and fittings shall be supplied with 304 stainless steel bolts, nuts, and washers.

C. The work in this section includes:

1. Butterfly valves
2. Plug valves
3. Gate valves
4. Check valves
5. Air and vacuum release valves
6. Miscellaneous valves

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09 91 00 - Painting

B. Section 40 23 00 - Process Piping and Pipe Fittings

C. Section 43 00 00 - Equipment, General Provisions

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch).
ANSI/ASME B31.1	Power Piping.
ASTM A 36	Specification for Structural Steel.
ASTM A 48	Specification for Gray Iron Castings.
ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
ASTM A 536	Specification for Ductile Iron Castings.
ASTM B 61	Specification for Steam or Valve Bronze Castings.
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings.
ASTM B 148	Specification for Aluminum-Bronze Castings.

ASTM B 584	Specification for Copper Alloy Sand Castings for General Applications.
ANSI/AWWA C500	Gate Valves for Water and Sewerage Systems.
ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
ANSI/AWWA C507	Ball Valves 6 Inches Through 48 Inches.
AWWA C508	Swing-Check Valves for Waterworks Service, 2 Inches through 24 Inches NPS.
ANSI/AWWA C509	Resilient-Seated Gate Valves for Water and Sewage Systems.
AWWA C517	Resilient-Seated Cast-Iron Eccentric Plug Valves
AWWA C550	Protective Interior Coatings for Valves and Hydrants.
SSPC-SP-2	Hand Tool Cleaning.
SSPC-SP-5	White Metal Blast Cleaning.

1.4 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Shop drawings of all valves and operators, including associated wiring diagrams and electrical data, shall be furnished as specified in Section 01 33 00 “Submittals”.

B. **Valve Labeling:** The CONTRACTOR shall submit a schedule of valves to be labeled, indicating in each case the valve location and the proposed wording for the label.

1.5 QUALITY ASSURANCE

A. **Valve Testing:** Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its designed water-working pressure.

B. **Bronze Parts:** Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62 or, where not subject to dezincification, to ASTM B 584.

PART 2 -- PRODUCTS

2.1 BUTTERFLY VALVES (AIR OR GAS SERVICE)

A. **Body:** The valve body shall be cast iron conforming to ASTM A126, Class B, with either wafer, lug, or flanged design with rated pressure of 75 psig.

B. **Disc:** The disc shall be of ductile iron conforming to ASTM A126 Class B with an edge of Monel, nickel, or stainless steel. Sprayed or plated disc edges are not acceptable.

C. **Seat:** The elastomer seat shall be in the body. The seat material shall be Viton or material suitable for temperatures up to 250º F.

D. **Shaft:** The valve shaft shall be 416 stainless steel.

E. **Bearings:** All shaft bearings shall be self-lubricating bronze.

F. **Painting:** All valve bodies shall be epoxy coated.

G. **Pressure Drop:** At 5000 fps air velocity, the pressure loss through each valve shall not exceed 0.02 psi.

H. **Manual Operators:** Valves 8 inches and smaller shall be lever actuated. Valves larger than 8-inches shall be handwheel or chain wheel actuated.

I. Manufacturers or Equal:

1. Henry Pratt
2. DeZurik Corporation

2.2 PLUG VALVES

A. Plug valves shall be of the non-lubricated, eccentric type with resilient-faced plugs, flanged, or mechanical joint ends as shown on the plans. Port areas of 4"-20" valves shall be at least 80% of the full pipe area unless noted differently on plans. Port areas of 24" valves shall be not less than 70% of the full pipe area. Valves 2 ½" through 12" shall be bubble-tight up to 175 psi and up to 150 psi for valves 14" through 36". A test report shall be furnished as described in AWWA 517 when requested. Bodies shall be semi-steel with raised seats. Seats shall have a welded-in overlay of not less than 95% pure nickel on all surfaces contacting the plug face. Valves shall be furnished with replaceable sleeve-type bearings conforming to AWWA C-517. Bearing shall be of sintered, oil-impregnated type 316 stainless steel. All valves 4" and larger shall be of the bolted bonnet design. Operating shaft seal on all valves shall be Buna "U" cups, adjustable type. Shaft seals on valves 4" and larger shall be repairable without removing the valve bonnet. Flanged valves shall be furnished with ANSI/AWWA standard 125# flanges. Mechanical joint type ends shall conform to ANSI A21.11. The valves shall conform to AWWA C-517 end-to-end dimensions. Grooved end plug valves as manufactured by Victaulic, may be used in lieu of flanged valves in the interior locations. Grooved end valves shall conform to AWWA C-606 dimensions.

B. Plug valves 3" or smaller shall be equipped with lever actuators. Plug valves 4" through 6" shall be equipped with a heavy 2" square operating nut for wrench operation unless indicated otherwise on the plans or specifications. A total of 6 wrenches shall be provided for operating the operating unit.

C. Valves 8" and larger shall be equipped with gear actuators limiting operating pull to not more than 80 lbs. on handwheels unless shown on the plans to be furnished with pneumatic actuators. All gearing shall be enclosed and suitable for running in oil, with seals provided on all shafts to prevent the entry of dirt and water into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Actuators shall clearly indicate valve position, and an adjustable stop shall be provided to set closing torque. If V-type packing is used, then valve packing adjustment on non-submerged valves shall be accessible without removing the actuator from the valve. The construction of actuator housing shall be semi-steel. All exposed nuts, bolts, and washers on actuators shall be zinc plated.

D. Torque computations for valve operator and hand wheel sizing shall be based on the maximum full pressure rating of the valve, 175 psi for 2-1/2" through 12" and 150 psi for 14" through 36". All actuator components shall be designed to withstand without damage, a rim pull of 200 lbs. for handwheel or chain wheel, and input torque of 300 ft-lb for wrench nuts.

E. Valves and actuators for exterior underground service or in-basin service shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets for such service shall be totally enclosed and have gasket seals. Valves for buried service and inside hydraulic structures shall be provided with extension stems, road boxes (as required for proper service), and other necessary appurtenances. Road boxes shall be at finished grade. Handwheel operators shall be installed as shown on the plans.

F. All buried or submerged valves shall be provided with geared actuators.

G. Plug valves are to be installed per the manufacturer's instructions and per AWWA C517, Section A.5.

H. Manufacturers or Equal:

1. DeZurik Corporation
2. Clow
3. Valmatic
4. Milliken
5. Henry Pratt
6. Other Manufacturers Approved by the ENGINEER

2.3 GATE VALVES

A. Resilient-Seated Gate Valves

1. Resilient seated gate valves shall be used in all sewage and sludge piping where gate valves are indicated. Valves shall conform to AWWA C509 specifications.
2. Resilient seated gate valves shall consist of a gate with a bonded elastomer seat. Valves shall be rated for bubble-tight seal in both directions at a 200 psi pressure differential. Stem shall be a non-rising type with hand-held or shaft extension and floor-mounted operating stands as indicated. The stem shall be a corrosion-resistant threaded bronze stem and be used with a bronze stem nut. All cast iron or ductile iron internal parts shall be coated with a corrosion-resistant epoxy coating. All internal parts shall be accessible without removing the valve body from the piping.
3. Valves and actuators for exterior underground service or in-basin service shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets for such service shall be totally enclosed and have gasket seals. Valves for buried and in-basin installations shall be provided with extension stems, road boxes (as required for proper service), and other necessary appurtenances. Road boxes shall extend to the finished grade level. Handwheel operators shall be installed as shown on the plans.
4. Manufacturers or Equal:
   (a) Kennedy Valve Manufacturing Co. (ITT Grinnell)
   (b) Clow Corporation
   (c) Mueller Company
   (d) Water Technology Resources

2.4 CHECK VALVES

A. Double-Leaf Check (Air and Gas Service)

1. Check valves shall be of the double-gate, springless, and seatless design with cast iron body, bronze discs, stainless steel center shaft, and Viton seat suitable up to 350°F. Valves shall be suitable for installation between ANSI standard 150# flanges.
2. Manufacturers or Equal:
   (a) APCO Series 9000
   (b) TRW Mission Manufacturing Co. (Duo-check)

(c) Val-Matic (Valve and Manufacturing Corporation)

(d) Technocheck Silent Seatless Check Valve

B. Rubber Flapper Swing Check Valve

1. The rubber flapper swing check valve shall have a heavily constructed ductile iron body and cover. The body shall be a long pattern design (not wafer), with integrally cast-on-end flanges. The flapper shall be Buna-N having an "O" ring seating edge, and be internally reinforced with steel.

2. Flapper is to be captured between the body and the body cover in a manner to permit the flapper to flex from a closed to a full-open position during flow through the valve. The flapper shall be easily removed without the need to remove the valve from the line. Check valves to have a full pipe-size flow area. The seating surface is to be on a 45°angle requiring the flapper to travel only 35° from closed to full-open position for minimum head loss and non-slam closure.

3. Buna-N flapper (Hi-Strength coated fabric - coated on both sides with 70 Duro), which creates an elastic spring effect, molded internally, to assist the flapper in closing against a slight head to prevent slamming.

4. Valve is designed for 175 psi working pressure for water.

5. An external backflow device shall be furnished.

6. Materials of construction shall be certified in writing to conform to ASTM specifications as follows:

Body & Cover	Ductile Iron	ASTM A126 GR. B
Flapper	Buna-N	
Lining	Epoxy Lined	
Exterior Paint	Phenolic Primer Red Oxide	RDA approved for potable water contact.

7. Manufacturers or Equal

(a) APCO Series 100

(b) Valmatic

(c) Milliken Flex Check

C. In-Line Elastomeric Check Valve

1. In-line check valve shall fit entirely within the pipe diameter and be easily inserted, anchored, and sealed regardless of pipe condition.

2. The port area shall contour into a circumferential sealing area, preventing backflow of both air and liquids.

3. Once installed, the check valve shall not protrude beyond the face of the structure.

4. The check valve shall be ply-reinforced throughout the body, saddle, and bill, which are cured and vulcanized into a one-piece unibody construction.

5. Provide accredited hydraulic test data to confirm the minimum pressure required to open the check valve.

6. Manufacturer or Equal

(a) Red Valve

D. Plastic Ball Check (Chemical/Corrosive Fluids)

1. Plastic ball check valves for corrosive fluids, in sizes up to 4-inch shall be used for vertical upflow conditions only.

2. **Construction:** The valve bodies and balls shall be of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polyvinylidene fluoride (PVDF), or polypropylene (PP) construction, as best suited for each individual service condition. They shall have unions with socket connections or flanged ends conforming to ANSI B16.5, Class 150. All seals shall have Viton O-rings, and valve design shall minimize the possibility of the balls sticking or chattering. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F.

3. Manufacturers or Equal:

(a) ASAHI-AMERICA;

(b) Hayward Plastic Products;

(c) NIBCO Inc. (Chemtrol).

E. Plastic Swing Check Valves (Chemical/Corrosive Fluids)

1. **General:** Plastic swing check valves for corrosive fluids, in sizes up to 8 inches, may be used for horizontal or vertical upflow conditions.

2. **Construction:** The valve bodies and discs shall be of PVC, PP, or PVDF construction, as best suited for each individual service condition. They shall have flanged ends conforming to ANSI B16.5, Class 150, and flanged top access covers, and they shall shut positively at no-flow conditions. The seats and seals shall be of EPDM, Teflon, or Viton. The PVC valves shall be rated for a maximum non-shock working pressure of 150 psi at 73 degrees F for sizes 3 inches and smaller. For larger sizes and other materials and temperatures, the pressure rating will be lower.

3. Manufacturers or Equal:

(a) ASAHI-AMERICA;

(b) Hayward Plastic Products.

2.5 PRESSURE RELIEF VALVES

A. Pressure relief valves shall be placed in floor slabs of clarifiers and aeration basins, as shown in the plans.

B. Pressure relief valves shall be 4-inch diameter and furnished in body lengths as shown in valve details on the plans. Valves shall be cast iron with neoprene seal material between the cover and the top of the body. Valves shall be so constructed that neither the cover nor the strainer can become separated from the body of the valve due to groundwater pressure.

C. Valves shall be manufactured by Neenah Foundry Company, Clow Corporation, or equal.

2.6 AIR AND VACUUM RELEASE VALVES (SEWAGE APPLICATIONS ONLY)

A. The Combination Air Valve shall be designed to exhaust large amounts of air during filling, release small amounts of accumulated air during operation, and admit large amounts of air upon impending vacuum during draining.

B. The valve shall be float operated, and the Air & Vacuum and Air Release functions shall be housed in a single body. The body and cover shall be housed in a single body. The body and cover shall be cast iron, conforming to ASTM A126, Class B. All leverage mechanism parts, and the float, shall be

stainless steel. No plastic or bronze parts shall be permitted. The large and small orifice seats shall be Buna-N and renewable.

C. The Combination Air Valve shall be supplied with “Flushing Attachments” to allow periodic flushing of sediment, grease, and solids. Attachments consist of an inlet isolating valve, bronze blow-off, and flushing valves.

D. Manufacturers or Equal

1. APCO Series 440 SCAV
2. Crispin.
3. Valmatic
4. Henry Pratt Series WWCV Wastewater Combination Air Valve

2.7 YARD HYDRANTS

A. Yard hydrants shall be installed where shown on the plans. Each hydrant shall be of the freezeless type with brass piping with a 1-1/2-inch inlet and outlet. A 2-inch male hose thread nozzle and a 1-1/2” x 3/4” hose adapter shall be provided for all yard hydrants. The buried depth shall be seven feet. Hydrants shall stand plumb, and nozzles shall be located at least 24 inches above ground. Yard hydrants shall be similar to genuine Murdock hydrants or equal when the operating pressure is 85 psi or less. If the operating pressure is more than 85 psi, then the yard hydrant shall be Eclipse No. 2 post hydrant by Kupferle Foundry.

2.8 MISCELLANEOUS VALVES

A. PVC Ball Valves

1. Ball valves shall be designed for a water-working pressure of not less than 150 psi, constructed of PVC, and when in the fully open position, shall have a port diameter not less than Schedule 80 PVC pipe of the same nominal diameter. Valves shall be designed with union ends or top entry to permit the removal of the valve or the internals from the line and with end connectors designed for solvent welding to the pipe.
2. Ball valves shall be Chemtrol (a Division of NIBCO, Inc.), Certain-Teed Products Corp., ITT Grinnell, or equal.

B. Solenoid Valves

1. Solenoid valves shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim, and spring, Teflon, or other resilient seals with material best suited for the temperature and fluid being handled. Solenoid valves in a corrosive environment shall have stainless steel bodies. For chemicals and all corrosive fluids, solenoid valves with Teflon bodies and springs or other suitable materials shall be used. Unless indicated otherwise on the plans, the enclosure shall be NEMA, Type 1. All coil ratings shall be for continuous duty. For electrical characteristics, see electrical.
2. Valves shall be power to open or power to close as scheduled on plans. Solenoid valves for filter siphons shall be power to close.

3. Manufacturers or Equal:

   For general duty:

   (a) Automatic Switch Co. (ASCO), Model “RED HAT”

   (b) Skinner Valve Division of Honeywell, Model “LANCER”

   (c) Magnatrol Valve Corporation

   For corrosive fluids:

   (d) Valcor Engineering Corporation

   (e) +GF+ Plastic Systems, Inc.

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION

A. **General:** All valves, gates, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer’s written instructions and as shown and specified. All gates shall be adequately braced to prevent warping and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. **Access:** All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.

C. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the CONTRACTOR to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

**** END OF SECTION ****

SECTION 40 23 00 - PROCESS PIPING AND PIPE FITTINGS

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install all piping systems shown and specified in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, excavation, backfill, and encasement, to provide a functional installation.

B. The piping shown is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the CONTRACTOR's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

C. All valves and fittings shall be supplied with 304 stainless steel bolts and washers.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 09 91 00 - Wastewater Treatment Facility Painting

C. Section 31 23 00 - Excavating and Backfilling

D. Section 33 00 00 - Site Utilities

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids.
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
ANSI/AWWA C115/A21.15	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges.
ANSI/AWWA C150/A21.50	Thickness Design of Ductile-Iron Pipe.
ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
ANSI/AWWA C153/A21.53	Ductile-Iron Compact Fittings, 3 in. Through 12 in. for Water and Other Liquids.
ASTM C150	Specification for Portland Cement.

ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
ASTM A139	Specification for Electric-Fusion (ARC) welded steel pipe (NPS 4 and over).
ASTM A312	Specification for seamless and welded Austenitic stainless steel pipes.
ASTM A234	Specifications for pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures.
ASTM A774	Specification for as-welded wrought Austenitic stainless steel fittings for general service at low and moderate temperatures.
ASTM D1785	Specification for Polyvinyl Chloride Plastic Pipe, Schedules 40, 80 and 120.
ASTM D2241	Specification for Polyvinyl Chloride Pressure-Rated Pipe (SDR Series).

1.4 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit complete shop drawings and certificates, test reports, and affidavits of compliance of all piping systems, in accordance with the requirements in Section 01 33 00, "Submittals". The submittals shall include detailed layout, spool, or fabrication drawings that show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.

PART 2 -- PRODUCTS

2.1 PIPES AND FITTINGS

A. Ductile Iron Pipe and Fittings

1. Ductile iron pipe shall conform to the requirements of ANSI A21.51 (AWWA C151) standard specification for centrifugally cast ductile iron pipe for water or other liquids.

2. Ductile iron pipe in exterior locations shall be provided with either mechanical joint type or push-on type ends and shall be of ANSI/AWWA thickness class as follows:

Pipe Diameter	ANSI Thickness Class
4"	Class 51
6" or larger	Class 50

3. Ductile iron pipe in interior locations shall be provided with flanged or mechanical joint-type ends as shown in the plans. All interior ductile iron piping shall be ANSI/AWWA thickness Class 53 (minimum). Grooved and shouldered type joints conforming to AWWA C606 will be permitted and, at some locations, are designated for use for special applications or for clearance.

4. Ductile iron flanges shall conform to ANSI/AWWA C115 standard 125# template and be rated for 250 psi. Mechanical and push-on joints shall conform to ANSI/AWWA C111, Standard for rubber gasket joints for ductile iron and gray iron pressure pipe and fittings.

5. Unless otherwise shown on the plans, ANSI/AWWA short-body ductile iron fittings shall be furnished. Short body fittings shall conform to ANSI/AWWA C110. Flanged long radius elbows, reducing on-the-run tees, side outlet fittings, eccentric reducers, and laterals shall conform to ANSI B16.1 standard specification for flanged fittings and flanges. Restraint joint type fittings,

EBAA Iron Megalug Series 1100 or equal, conforming to ANSI/AWWA C153/A21.53, shall be supplied for mechanical and push-on joints.

6. The interior coating for the ductile iron pipe and fittings shall be cement mortar lined with asphalt seal coating. Pipe used for buried locations shall be furnished with standard bituminous exterior coating. Pipe used for interior and exposed location shall not have a bituminous exterior coating but shall be furnished with a shop primed coating of Tnemec Primer, or equal, to facilitate painting as specified in Section 09 91 00.

B. Steel Pipe (Aeration Air)

1. Aeration air piping shall be 0.250-inch wall thickness, spiral weld (ASTM A139 Grade B) carbon steel, or Seamless or electric-resistance-welded (ASTM A53 Grade B).

2. All above-grade aeration air piping shall be coated with epoxy protective coating in accordance with Coating System A, Section 09 97 13. All piping shall be shop coated with coating deleted within 6 inches of field welds. After field welding, joints shall be cleaned and coated. All scratches and breaks in the shop-applied coating shall be scarified and repainted. The field coating system for weld connections shall be Epoxy Coating System A or Coal Tar Epoxy Coating System C. Tape coating such as Tapecoat 10/40W is also acceptable for field joint coating systems. Tape shall be 50 mils thick and conform to AWWA Standard 209. Surface preparation, priming, and tape application shall be per the manufacturer's standard application instructions. The interior of the aeration air piping does not require coating.

3. Aeration air pipe fittings shall be carbon steel, the Schedule to match adjoining pipe, ASTM A234 Grade B, seamless or welded, butt weld ends. Fittings 14 inches and larger may be metered construction conforming to AWWA C-208, Table 2, and butt weld ends.

4. Aeration air piping flanges shall be AWWA C-207 Class "D" Ring type flanges, slip-on or weld neck, bored to match the schedule of adjoining pipe. All exterior, above-grade flange bolts shall be Type 18-8 stainless steel.

5. All outdoor pipe support anchor bolts and hardware shall be stainless steel. Pipe supports shall be epoxy coated.

6. The external surfaces of the buried steel pipe shall be coated with coal-tar enamel in accordance with AWWA C203.

7. Ductile iron pipe, as specified in Paragraph 2.1 A, without the interior cement mortar lining and with gaskets (free of asbestos) rated to 250°F or higher, may be used in lieu of welded steel pipe if approved by the ENGINEER.

C. PVC Pipe and Fittings

1. Outfall pipe shall be as specified in Section 33 00 00 "Site Utilities". This section shall be used for PVC pipe and fittings inside the treatment plant site.

2. Pressure pipe and fittings shall be as follows: pipe for buried application shall be SDR 26, ASTM D2241, or for potable water shall be AWWA C-900 DR 18 unless noted otherwise; pipe for solvent welded applications shall be schedule 80, ASTM D1785 and fittings shall be ASTM D2464. Pipe inside the buildings shall be supported at intervals not to exceed 4'-0".

3. Gravity sewer pipe shall be as specified in Section 33 00 00 "Site Utilities".

D. Polyethylene Pipe and Fittings

1. See Section 33 00 00 "Site Utilities" for buried PVC piping.

2. See Sections 22 11 00 and 22 13 00 for interior PVC piping.

E. Stainless Steel Pipe

1. Stainless steel pipe may be utilized for wastewater piping and aeration piping.
2. Stainless steel pipe shall be type 304L, conforming to ASTM A-778.
3. Thicknesses shall be as follows:
   (a) Pipeline diameter 8” and smaller: Schedule 5S
   (b) Pipeline diameter 10” and greater: Schedule 10S
4. Fittings shall be butt weld type manufactured in accordance with ASTM A-774 of the same raw material and in the same thickness as the pipe.
5. Flanged pipe ends shall be Type 304L stainless steel slip-on type rolled angle face rings and primed ductile iron backup flanges drilled to ANSI 16.1 Class 125 standard.
6. Red rubber gaskets shall be provided which meet the hydrostatic test pressure requirements.
7. Piping system working pressure shall be 150 psi.
8. All welding shall be a gas tungsten arc welding (GTAW) process, filter metal of equal or superior ELC grades, and shall be added to all welds to provide cross-sections at the weld equal to or greater than the parent metal.

2.2 RUBBER EXPANSION JOINTS (FLEXIBLE CONNECTORS)

A. Flexible Connector

1. Flexible connectors shall be Metra-Flex Style 711 or Mercer Rubber Style 450, filled single-arched style with control rods to prevent overextension. The connectors shall be able to withstand pressure from 150 psig to 10 in. Hg vacuum and temperature from 20°F to 240°F. The ends shall be able to mate to 125 lbs. ANSI flanges. The connectors shall be of molded construction made of Buna-N.

2.3 COUPLINGS

A. Flanged Coupling Adapters (FCA)

1. Flanged coupling adapters shall be provided where indicated. CONTRACTOR may install additional FCA at no additional cost as he desires for ease of piping installation. FCA and piping shall be secured against movement with fixed supports or tie rods. FCA shall be Dresser Style 127, Rockwell/Smith-Blair Type 912, Romac or equal with anchor studs for 12 inches and under; Type 913 for 14 inches and over. Coupling adapters shall be of cast iron construction with shop coating.

B. Sleeve-Type Couplings

1. Flexible sleeve-type pipe couplings shall be installed where shown on the plans or for transition between pipe materials. Couplings shall be provided as recommended by the pipe manufacturer to accommodate pipe movement due to temperature changes and shall be constructed of materials compatible with the contained fluid. Couplings and piping on pressure lines shall be secured against movement with tie rods. Couplings shall be suitable for the type and dimension of pipes to be connected. The interior of steel middle rings shall be epoxy-coated. Couplings shall be manufactured by Dresser, Smith-Blair/Rockwell, or equal.

C. Mechanical Couplings

1. Couplings: Dresser Style 38, Rockwell/Smith-Blair 411 or 441 or equal without pipe stop.
2. Gaskets: Oil-resistant synthetic rubber meeting the requirements of ASTM D2000.

D. Grooved End Couplings.

1. Ductile Iron Pipe Couplings
   (a) Coupling: Victaulic Style 31 or equivalent Grinnell Gruvlok.
   (b) Gasket: Grade M flush seal gasket.
2. Steel Pipe Couplings
   (a) Coupling: Victaulic Style 77 or Style 07 or equivalent Grinnell Gruvlok.
   (b) Gasket: Grade E rubber gaskets.
3. PVC Pipe Couplings
   (a) Coupling: Victaulic Style 775 or equivalent Grinnell Gruvlok.
   (b) Gasket: Grade E rubber gasket.

2.4 WALL PIPES

A. Wall pipes shall be used wherever liquid is present on one or both sides of the wall or floor.

B. Ductile iron wall pipes shall be manufactured by Clow Corporation, American Cast Iron Pipe Company, or equal. Steel sleeves and water stop rings shall be Schedule 40 wall thickness, hot-dipped zinc-coated in accordance with ASTM A53. Sleeve and wall pipes installed below grade or through water-bearing walls shall be furnished with a waterstop ring. If welded, the ring shall be furnished with 360° welds. All wall and floor pipe penetration details shall be approved by the ENGINEER.

C. Wall pipes shall be poured in place and sufficiently braced so as to prevent loss of alignment during the pouring of concrete.

D. In lieu of wall pipes, the ENGINEER may approve “Omni Sleeve” type wall sleeves at selected locations. The CONTRACTOR shall obtain prior approval from the ENGINEER to use these sleeves.

2.5 WALL SLEEVES

A. Wall and/or floor pipe penetrations may be made by means of a sleeve capable of being bolted directly to the formwork to prevent misalignment.

B. Seal of the annular space between the carrier pipe and the sleeve shall be by means of a confined rubber (BUNA-S) gasket capable of withstanding 350 psi.

C. Sleeve shall be manufactured from Ductile Iron with an integrally cast waterstop of 1/2” minimum thickness and 2 1/2” minimum height.

D. Manufacturer or Equal

1. Omni® Sleeve

2.6 WALL SLEEVE - RUBBER LINK TYPE

A. Wall sleeves with rubber link seal will be permitted only for pipes of a diameter of 3 inches or less.

B. Sleeve shall be Schedule 40 galvanized steel pipe; sealing element shall be EPDM rubber; pressure plates shall be Delvin plastic; bolts and nuts shall be stainless steel.

2.7 PIPE HANGERS AND SUPPORTS

A. Pipe hangers or supports shall be furnished and installed for all interior or exposed process piping as shown on the plans or at intervals not to exceed 8'-0". Hangers shall be Grinnell Figure 260, Michigan Hanger No. 400 or equal. Hangers shall be supported by solid rods and nuts to brackets, concrete inserts, or as shown on the plans. Brackets shall be Grinnell Figure 195, Michigan Hanger No. 352 or equal. All supports shall be hot-dip galvanized.

B. Unless shown otherwise on the plans, pedestal supports shall be used when piping is installed at or near floor level and shall consist of galvanized floor flange, pipe, and saddle. Anchor bolts shall be provided where necessary. All supports shall be adjustable except when specifically shown otherwise on the Plans.

2.8 FLUSHING CONNECTION

A. Flushing connections shall be 1-1/2 inch connections where noted on the plans and shall be either tapped and threaded or furnished with a saddle depending on pipe size requirements.

B. Each connection shall consist of a 1-1/2 inch ball valve and female universal type quick-acting hose coupling and shall be Le-Hi, Foster, or equal.

2.9 TRACER WIRE

A. Tracer wire shall meet the requirements of one of the following:

1. 1/8" galvanized aircraft wire clear PVC coated to 3/16".
2. 1/8" 304 stainless steel wire clear PVC coated to 3/16".
3. #12AWG solid copper or copper clad steel (CCS) wire with 30mil high-density polyethylene (HDPE) insulating jacket.
4. Connectors
   (a) Connectors shall be "wire nut" or "twist on" type connectors filled with silicone waterproofing sealant suitable for direct bury applications according to UL 486D test standard. Connectors shall be DryConn™ connectors as manufactured by King Innovation or approved equal.
   (b) Approximately 1% slack shall be maintained in the wire by installing 101 feet of wire for every 100 feet of pipe length.
   (c) The Contractor shall successfully complete a conductivity test of the installed tracer wire system prior to final acceptance.

PART 3 -- EXECUTION

3.1 HANDLING

A. Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in handling and installing pipe and fittings shall not damage the pipe and fittings.

B. Hooks inserted in the ends of the pipe shall have broad, well-padded contact surfaces.

C. Pipe and fittings in which the cement lining has been damaged shall be replaced. Small and readily accessible damaged areas may be repaired.

D. All pipe coating that has been damaged shall be repaired by the CONTRACTOR before installing the pipe.

3.2 CUTTING PIPE

A. Cutting shall be done in a neat manner, without damage to the pipe or to the cement lining.

B. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed using a file to remove all roughness and sharp corners.

C. Ends of ductile iron pipe shall be cut with a saw, abrasive wheel, or oxyacetylene torch. Field-cut holes for saddles shall be cut with mechanical cutters; oxyacetylene cutting will not be permitted.

3.3 CLEANING

A. The interior of all pipes and fittings shall be thoroughly cleaned of foreign matter before being installed and kept clean until the work has been accepted.

B. Before jointing, all joint contact surfaces shall be wire-brushed, if necessary, wiped clean, and kept clean until jointing is completed.

C. Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other materials shall not be placed in or allowed to enter the pipe.

D. Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug which will prevent trench water from entering the pipe.

3.4 INSPECTION

A. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; spigot ends shall be examined with particular care.

B. All defective pipes and fittings shall be removed from the site of the work.

3.5 ALIGNMENT

A. Pipelines or runs intended to be straight shall be laid straight.

B. Deflection from a straight line or grade shall not exceed the values stipulated in Table 1 or Table 2 of AWWA C600 unless specially designed bells and spigots are provided.

C. Either shorter pipe sections or fittings shall be installed where the alignment or grade requires them.

3.6 PIPE LAYING

A. The type of pipe to be used shall be as shown in the plans. All pipes shall be laid and maintained to the required line and grade.

B. Proper implements, tools, and facilities satisfactory to the ENGINEER shall be provided and used by the CONTRACTOR for the safe and convenient prosecution of the work.

C. Cutting of pipe shall be done in a neat and workmanlike manner without damage to pipe or lining. Pipes shall be handled properly. Materials must at all times be handled with care to prevent damage.

Under no circumstances will the pipe be dropped or damaged. Hook ends shall not be used for installing or removing the pipe.

D. The pipe and fittings shall be inspected for defects and, while suspended above grade, be rung with a light hammer to detect cracks.

E. Every precaution shall be taken to prevent foreign material from entering the pipe while it is placed in the line. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

F. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to the correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Pipe joint deflection shall not exceed the manufacturer's recommendations.

G. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the ENGINEER.

H. Pipe shall be laid with bell ends facing in the direction of laying unless directed otherwise by the ENGINEER.

I. No pipe shall be laid in water or when, in the opinion of the ENGINEER, trench conditions are unsuitable.

3.7 ENCASEMENT OF PIPE IN CONCRETE UNDER STRUCTURES AND FOOTINGS

A. All piping under floors, structures, and footings shall be encased in concrete with a minimum compressive strength of 3000 psi. The length of the encasement shall extend at least 24 inches beyond the floor, structure, or footing exterior side.

3.8 FIELD JOINTS

A. Joints in buried locations shall be mechanical joint or push-on type unless otherwise indicated in the drawings.

B. Bells on wall castings and wall sleeves shall be a mechanical joint with tapped holes for tie rods or stud bolts.

C. All other joints shall be flanged unless otherwise indicated in the drawings.

3.9 MECHANICAL JOINTS

A. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled.

B. Over-tightening bolts to compensate for poor installation practice will not be permitted. Anchored mechanical joints (AMJ) with retainer glands or other suitable means of joint restraint shall be used where indicated in the drawings.

C. The holes in mechanical joints with tie rods shall be carefully aligned to permit the installation of the tie rods.

D. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

3.10 PUSH-ON JOINTS

A. The pipe manufacturer's instructions and recommendations for proper jointing operations shall be followed.

B. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean.

C. Each spigot end shall be suitably beveled to facilitate assembly.

D. Pipe ends for restrained joint pipe shall be prepared in accordance with the pipe manufacturer's recommendations.

3.11 FLANGED JOINTS

A. Pipe shall extend completely through screwed-on flanges.

B. The pipe end and flange face shall be finish-machined in a single operation.

C. Flange faces shall be flat and perpendicular to the pipe centerline.

D. When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting, which would prevent uniform gasket compression, or which would cause unnecessary stress in the flanges.

E. One flange shall be free to move in any direction while the flange bolts are being tightened.

F. Bolts shall be tightened gradually and at a uniform rate so that gasket compression is uniform.

G. Special care shall be taken when connecting to pumping equipment to ensure that no stresses are transmitted to the pump flanges by the connected piping. All such piping shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire surface of the abutting pump and piping flanges are obtained before the installation of any bolts in those flanges.

H. Pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are tightened.

I. Each pump shall be leveled, aligned, and wedged in a position that will fit the connecting piping but shall not be grouted until the initial fittings and alignment of the connecting pipe so that the pump may be shifted on its foundation as necessary.

J. Each pump shall be grouted before the final bolting of the connecting piping as specified in Section 43 00 00, Paragraph 2.3 "Equipment Installation".

3.12 MECHANICAL COUPLINGS

A. Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. Pipe ends shall be clean and smooth.

B. A space of at least 1/4 inch and not more than one inch shall be left between the pipe ends.

3.13 GROOVED JOINTS

A. Piped systems with grooved joints may be provided in lieu of a screwed, flanged, welded, or mechanical joint system for above-grade steel and ductile iron process piping. Grooved-end couplings

will not be permitted in buried piping. The CONTRACTOR shall make the coupling manufacturer responsible for the selection of the correct style of coupling and gasket for each individual location.

B. Completed joints shall be rigid and not allow angular deflection or longitudinal movement.

C. Special care shall be taken when connecting to pumping equipment to avoid transmitting stresses to the pump flanges by the connected piping. Piping shall be permanently supported, so that accurate matching of piping and abutting pump flanges is obtained before the installation of any bolts in those flanges.

3.14 ANCHORAGE OF PROCESS PIPING

A. For all piping with mechanical or push-on joints, at all tees and at bends deflecting 22-1/2° or more, the movement shall be prevented by connecting sufficient joints together with a threaded rod to withstand the test pressure specified in Paragraph 3.14 or 1.5 times the working pressure whichever is higher. The restraining length shall be calculated according to Ductile Iron Pipe Research Association (DIPRA) “Thrust Restraint Design for Ductile Iron Pipe” manual. A safety factor of 1.5 shall be used to calculate the restrained length. Concrete thrust blocks shall not be used alone to anchor pressure piping.

3.15 HYDROSTATIC TESTING

A. Process piping may be field-tested for leakage at 100 psi in accordance with the appropriate section (hydrostatic tests) of AWWA C600-2017. Test pressure and duration shall be per AWWA C600-2017, and allowable leakage shall be determined in accordance with the formula:

$$L = \frac{S*D*\sqrt{P}}{148{,}000}$$

where factors and units are defined as follows: L=Leakage, S=Length (ft.), D = Nominal Diameter (in.), and P = Average Test Pressure (PSI).

CONTRACTOR shall conduct tests under supervision of the ENGINEER.

Line	Test Pressure*
Forcemains & Pressurized Mains	150 psi
Pressure Process Piping (Gravity)	50 psi
Two-Inch Water Service	150 psi

* Test pressure based on the elevation of the lowest point in the line under test and corrected to the elevation of the test gauge.

**** END OF SECTION ****

SECTION 40 73 00 - GAUGES

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install pressure gauges as specified, complete, including all fittings, snubbers, connections, gaskets, supports, and accessories in the locations shown or specified, all in accordance with the requirements of the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 43 00 00 - Equipment General Provisions

PART 2 -- PRODUCTS

2.1 PRESSURE AND VACUUM GAUGES (NON-CHEMICAL)

A. **General:** Pressure gauges shall be provided on suction and discharge connections to pumps; on discharge connections from blowers and compressors; on each side of pressure-reducing valves; and where shown. Vacuum gauges shall be provided for vacuum pumps and where shown. In all locations where pressures may vary from below to above the atmospheric head, compound gauges shall be installed.

B. **Gauge Construction:** Gauges shall be an industrial quality type with Type 316 stainless steel movement and stainless steel or alloy case. Unless otherwise shown or specified, gauges shall have a 4-inch dial, 1/4-inch threaded connection, a Type 316 stainless steel snubber adapter, and a shut-off valve. Gauges shall be calibrated to read in psi or feet of water, with an accuracy of +/- one percent. Ranges required for each pressure indicator will be provided during the shop drawing review and are intended to be standard ranges. All gauges shall be vibration and shock resistant and filled with glycerin.

C. **Diaphragm Seal:** Gases not attached to clean water lines shall be equipped with diaphragm-type isolator units with 1/4-inch flushing connections unless noted otherwise. Isolators shall have: stainless steel diaphragms for pressure over 15 psi, and elastomer diaphragms for pressures of 15 psi and below, and shall be filled with a mixture of glycol and water. Diaphragm seals shall be manufactured by Ashcraft, Model 101; Marshalltown, series 225-01 or equal. Diaphragm seals shall be provided with a 1/4” Sch 80 steel nipple and 1/4 steel ball valve to facilitate flushing.

D. Gauge Manufacturers or Equal:

1. Marsh Instrument Company
2. Ashcroft Industrial Instruments (Dresser)
3. Foxboro/Jordan, Inc.
4. Marshalltown Instruments, Inc.
5. Ametek U.S. Gauge

E. Snubber Suppliers, or equal:

1. Cajon Company
2. Weksler Instruments, Corp.

2.2 PRESSURE GAUGES (CHEMICAL FEED EQUIPMENT)

A. **General:** Pressure gauges shall be provided on chemical feed pumps as described in the chemical feed equipment section and or as shown in the chemical feed schematic diagram. For the chlorine system, non-liquid-filled gauges shall be provided.

B. **Gauge Construction:** Gauges shall be an industrial quality type with Type 316 stainless steel movement and stainless steel or alloy case. Unless otherwise shown or specified, gauges shall have a 4-inch dial, 1/4-inch threaded connection, a Type 316 stainless steel snubber adapter, and a shut-off valve. The case shall be 304 SS with a Polycarbonate lens. Bourdon tube shall be drawn seamless 316 SS tube. Gauges shall be calibrated to read in psi or feet of water, with an accuracy of +/- one percent. The chlorine system will require vacuum gauges. The chemical feed supplier shall indicate the range for the gauges proposed. All gauges shall be vibration and shock resistant and filled with glycerin.

C. **Pulsation Dampeners:** BLACOH Sentry Model RC00T-5 with CPVC house for wetted and non-wetted parts and PTFE diaphragm. Inlet size 1/2" FNPT Gauge Port 1/4” NPT

D. Manufacturer’s or Equal

1. Winters Premium Stainless Steel Liquid Filled Gauges

2. Equal

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All gauges shall be installed with the face in the vertical position at the locations shown in the Contract Documents and in strict accordance with the manufacturer’s printed instructions. Care shall be taken to minimize the effect of water hammer or vibrations on the gauges.

**** END OF SECTION ****

SECTION 43 00 00 - EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The Contractor shall furnish all equipment not designated as OWNER furnished in the bidding documents.

B. The Contractor shall install all equipment complete with necessary appurtenances to provide a complete and operable system.

C. The Contractor shall furnish complete shop drawings of all mechanical equipment, together with appurtenant piping, valves, and controls.

D. Each item of equipment shipped shall have a legible identifying mark or tag corresponding to the equipment number shown or specified for the particular item.

E. All equipment shall be designed to meet federal and state noise levels and safety requirements.

F. The Contractor shall furnish and install all oils and lubricants required for initial equipment start-up.

G. Contractor's bid price shall include the costs of any necessary manufacturer's representatives which may be required for equipment installation and start-up. Unless otherwise specified, a manufacturer's field representative shall be provided for a minimum of 8 hours of start-up services for each piece of process equipment.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 05 55 00 - Miscellaneous Metal Work

C. Section 09 91 00 - Wastewater Treatment Facility Painting

D. Section 26 05 00 Common Work Results for Electrical

E. Section 26 24 19 - Motor Control

F. Section 26 24 20 - Electric Motors

G. Section 26 90 01 - Measuring and Control Instruments

H. Section 26 90 02 - System Control

I. Section 40 05 60 - Valves

J. Section 40 23 00 - Process Piping and Pipe Fittings

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes:

1. International Building Code (IBC) - Latest Edition

2. National Electric Code ANSI/NFPA 70

3. References herein to “Plumbing Code” or NPC shall mean the National Plumbing Code of the American Public Health Association and the American Society of Mechanical Engineers (APHA/ASME). The latest edition of the codes, as adopted as of the date awarded by the agency having jurisdiction, shall apply to the work herein.

B. Commercial Standards

All equipment, products, and their installation shall be in accordance with the following standards, as applicable, and as specified in each Section of these specifications:

1. American Society for Testing and Materials (ASTM).
2. American Public Health Association (APHA).
3. American National Standards Institute (ANSI).
4. American Society of Mechanical Engineers (ASME).
5. American Water Works Association (AWWA).
6. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
7. American Welding Society (AWS).
8. National Fire Protection Association (NFPA).
9. Federal Specifications (FS).
10. National Electrical Manufacturers Association (NEMA).
11. Manufacturer’s published recommendations and specifications.
12. General Industry Safety Orders (OSHA).

The following standards have been referred to in this Section of the specifications:

ANSI B16.1-98	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800.
ANSI B16.5-96	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys.
ANSI B46.1-2009	Surface Texture.
ANSI S12.6-2008	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors.
ANSI/ASME B1.20.1-2005	General Purpose Pipe Threads (Inch).
ANSI/ASME B31.1-2007	Power Piping.
ANSI/AWWA D100-2006	Welded Steel Tanks for Water Storage.
AWWA C206-2011	Field Welding of Steel Water Pipe.
ASTM A 48-2003	Specification for Gray Iron Castings.
ASTM A 108-2007	Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.

1.4 CONTRACTOR SUBMITTALS

A. Shop Drawings: The CONTRACTOR shall furnish complete shop drawings for all equipment specified in the various Sections, together with all piping, valves, and controls for review by the ENGINEER in accordance with Section 01 33 00 entitled “Submittals”.

B. O & M Manuals: Complete and descriptive operation and maintenance manuals shall be submitted in accordance with Section 01 33 00 entitled “Submittals”.

C. Tools: The CONTRACTOR shall supply one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best-quality hardened steel forgings with bright, finished heads, with work faces dressed to fit nuts. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

D. Spare Parts: The CONTRACTOR shall obtain and submit from the Supplier a list of suggested spare parts for each piece of equipment. After approval, he shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. He shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

E. Torsional Analysis: The CONTRACTOR shall furnish to the ENGINEER a torsional analysis of the following, which shall be submitted in accordance with Section 01 33 00 entitled “Submittals”.

1. All engine drives.
2. All blowers and compressors with drives of 100 horsepower and over.
3. All other equipment where specified.

1.5 QUALITY ASSURANCE

A. Inspection, Start-up, and Field Adjustment: The CONTRACTOR shall demonstrate that all equipment meets the specified performance requirements. Upon completion of the installation of mechanical equipment controls, the CONTRACTOR shall provide the services of an experienced, competent, and authorized service representative of the manufacturer or supplies of each item of major equipment who shall visit the site of work to perform the following tasks:

1. Assist the CONTRACTOR in the installation of the equipment.
2. Inspect, check, adjust if necessary, and approve the equipment installation.
3. Startup and field-test the equipment for proper operation, efficiency, and capacity.
4. Perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the ENGINEER.
5. Instruct the OWNER’s personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment.

B. The costs of all inspection, start-up, testing, adjustment, and instruction work performed by said factory-trained representatives shall be borne by the CONTRACTOR.

C. Public Inspection: It shall be the responsibility of the CONTRACTOR to inform the local authorities, such as building and plumbing inspectors, fire marshals, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, etc., to obtain all required permits and certificates, and pay all fees.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Noise Level: When in operation, no single piece of equipment shall exceed the OSHA noise level requirements for a one-hour exposure.

B. Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Unless otherwise specified, the following load classifications shall apply in determining service factors:

Type of Equipment	Load Classification
Blower:	
Centrifugal or vane	Uniform
Lobe	Uniform
Reciprocating Air Compressor:	
Multi-Cylinder	Moderate Shock
Single-Cylinder	Heavy Shock
Pump:	
Centrifugal or Rotary	Uniform
Reciprocating	Moderate Shock
Diaphragm	Moderate Shock
Mixer:	
Constant Density	Uniform
Variable Density	Moderate Shock
Crane or Hoist	Moderate Shock
Fans	Uniform

C. For service factors of electric motors, see Section 26 24 20 - Electric Motors. Where load classifications are not specified, the best modern practice shall be used.

D. Welding: Unless otherwise specified or shown, all welding shall conform to the following:

1. Latest revision of ANSI/AWWA D100.
2. Latest revision of AWWA C206.
3. All composite fabricated steel assemblies to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent the entrance of air or moisture.
4. All welding shall be by the metal-arc or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing the same.
5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and control dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. All sharp corners of material to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

E. Protective Coatings: All equipment shall be painted or coated in accordance with Section 09 91 00 entitled "Painting" unless otherwise approved by the ENGINEER. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

F. Protection of Equipment: All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. All equipment shall be protected from

exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided to prevent the accumulation of condensate in gears and bearings.

G. Identification of Equipment Items: Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number shown or specified for the particular item.

H. Vibration Level: All equipment subject to vibration shall be provided with restrained spring-type vibration isolators or pads per the manufacturer's written recommendations.

I. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the approved shop drawings.

2.2 ANCHORING OF MECHANICAL EQUIPMENT

A. Equipment that does not vibrate during normal operation shall be rigidly attached to the foundation or other adequate support to prevent lateral and vertical displacement. Equipment that vibrates during normal operation shall be provided with isolators with mechanical stops securely anchored to the foundation or other adequate support.

B. Jacking screws shall be provided in the equipment bases and bedplates to aid in leveling prior to grouting.

C. Equipment suppliers shall furnish anchor bolts, nuts, washers, and sleeves of adequate design as required for the proper anchorage of the bases and bedplates to the concrete bases. Sleeves shall be a minimum of 1-1/2 times the diameter of the anchor bolts. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

D. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.

E. All bolts and anchor bolts, buried, submerged, or below the top of the wall of any hydraulic structure shall be of Type 18-8 stainless steel.

F. The Contractor shall submit, along with the mechanical equipment shop drawings, complete details showing the method of anchoring equipment and/or mechanical stops in full compliance with these requirements. All engineering required to comply with these provisions shall be the Contractor's responsibility. Submittals shall state the weight of the equipment, materials of the anchor system, and show all information in sufficient detail to permit an evaluation of its structural adequacy. Submittals not meeting these requirements in full will be returned, not approved, with deficiencies noted. The Contractor shall be required to correct all deficiencies and resubmit the proposed system of anchorage for approval.

2.3 EQUIPMENT INSTALLATION

A. The Contractor shall obtain installation instruction booklets or other recommendations from the equipment manufacturers as to procedures for, sequence of, and tolerances allowed in equipment installation. In particular, the manufacturer's recommendations as to grout spaces required, the type of grout to be used, and tolerances for level and alignment, both vertical and horizontal, shall be obtained and followed. Whenever applicable, the Contractor shall obtain the service of a manufacturer's representative specifically trained in the erection of his equipment to supervise the installation.

B. Skilled craftsmen experienced in the installation of the equipment or similar equipment shall be used. Applicable specialized tools and equipment, such as precision machinist levels, dial indicators, and gauges, shall be utilized as required in the installations. The work shall be accomplished in a workmanlike manner to produce satisfactory equipment installation free of vibration or other defects.

C. All equipment shall be installed on a 3-inch high concrete housekeeping pad unless noted otherwise. After assembly and installation on the concrete base, each unit shall be leveled and aligned in place but not grouted until after the initial fitting and alignment of connecting piping. Each unit shall then be grouted to the concrete base. Each base and bedplate shall be completely filled with grout. The grout shall extend to the edge of each base or bedplate and shall be beveled at 45 degrees all around the unit. Grout that is exposed at horizontal surfaces shall be rounded to provide drainage to appropriate points. After the grout has set, jacking screws shall be removed, and nuts on anchor bolts shall be tightened, followed by an overall check on leveling and alignment. Should the equipment not meet tolerances of level and alignment, as recommended by the manufacturer, corrective measures shall be taken to obtain the tolerances required.

D. Non-shrink grout used in setting machinery and anchor bolts shall be made with a hydraulic-type cement which, when mixed with water according to the manufacturer's instructions, will harden rapidly to produce a permanent high-strength material. Non-shrink grout shall be POR-ROK, as manufactured by the Hallemite Manufacturing Company of Cleveland, Ohio; Burke-Stone manufactured by Burke Concrete Accessories, Inc., Oakland, California; or equal.

2.4 PROTECTION OF EQUIPMENT

A. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather-tight storage facilities such as warehouses.

B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces damaged prior to acceptance of equipment shall be repainted.

C. Electrical equipment, controls, and insulation shall be protected against moisture or water damage. All space heaters provided in the equipment shall be connected and operating at all times from the time of delivery until the equipment is placed in operation.

2.5 COUPLINGS

A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate angular misalignment, parallel misalignment, end float, and cushion shock loads. Where required for vertical shafts, 3-piece spacer coupling shall be installed.

B. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

C. Taperlock bushings may be used to provide for easy installation and removal on shafts of various diameters.

D. Where universal type couplings are shown, they shall be of the needle bearing type construction, equipped with commercial type grease fittings.

2.6 SHAFTING

A. General: All shafting shall be continuous between bearings and sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. All shafts shall rotate in the end bearings and be turned and polished, straight, and true.

B. Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as shown or specified unless furnished as part of an equipment assembly.

1. Low-carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

C. Differential Settlement: Where differential settlement between the driver and the driven equipment may be expected, a shaft of sufficient length with 2 sets of universal-type couplings shall be provided.

2.7 BEARINGS

A. General: Bearings shall conform to the standards of the Anti-Friction Bearings Manufacturing Association (AFBMA).

B. To ensure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and other important factors shall be considered in bearing selection.

C. All re-lubricative type bearings shall be equipped with a hydraulic grease fitting in an accessible location and have sufficient grease capacity in the bearing chamber.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to ensure maximum bearing life and best performance.

E. Bearing Life: Except where otherwise specified or shown, all bearings shall have a minimum B-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so specified, bearings shall have a minimum rated B-10 life expectancy corresponding to the type of service, as follows:

Type of Service	**Design Life (Years)**	**B-10 Design Life (Hours)**
	(whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be cast iron or steel, and bearing mounting arrangement shall be as specified or shown or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve-type bearings shall have a Babbitt or bronze liner unless otherwise shown.

2.8 GEARS AND GEAR DRIVES

A. Unless otherwise specified, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum

B-10 bearing life of 60,000 hours, and a minimum efficiency of 94 percent. Worm gears shall not be used.

B. All gear speed reducers or increasers shall be of the enclosed type, oil or grease-lubricated, and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be cast iron with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided.

C. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.

D. Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

E. Oil level and drain location relative to the mounting arrangement shall be considered in the selection of gear drives. Oil drains shall be provided with adequate clearance to allow for a container of sufficient size to be placed to collect the full amount of oil to be drained. Oil coolers or heat exchangers with all required appurtenances shall be furnished when necessary.

F. Where gear drive input or output shafts have to connect to couplings or sprockets supplied by others, the CONTRACTOR shall have the gear drive manufacturer supply a matching key taped to the shaft for shipment.

2.9 DRIVE CHAINS

A. Power drive chains shall be commercial-type roller chains and meet ANSI Standards.

B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.

C. A minimum of one connecting or coupler link shall be provided with each length of the roller chain.

D. Chain and attachments shall be the manufacturer's best standard material suitable for the process fluid.

2.10 SPROCKETS

A. General: Sprockets shall be used in conjunction with all chain drives and chain-type material handling equipment.

B. Materials: Unless otherwise specified, materials shall be as follows:

1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.

2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of a minimum of 0.20 percent carbon steel.

3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.

C. All sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.

D. Finish bored sprockets shall be furnished, complete with keyseat and set screws.

E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with taper-lock bushings as required.

F. Idler sprockets shall be furnished with brass or Babbitt bushings, complete with an oil hole and axial or circumferential grooving. Steel collars with set screws may be provided on both sides of the hub.

2.11 V-BELT DRIVES

A. V-belts and sheaves shall be of the best commercial grade and conform to ANSI, MPTA, and RMA standards.

B. Unless otherwise specified, sheaves shall be machined from the finest quality gray cast iron.

C. All sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.

D. To facilitate installation and disassembly, sheaves shall be furnished, complete with taper-lock or QD bushings as required.

E. Finish bored sheaves shall be furnished, complete with keyseat and set screws.

F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.12 DRIVE GUARDS

A. All power transmission, prime movers, machines, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910).

2.13 FLEXIBLE CONNECTORS

A. General: Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of Section 40 23 00 entitled “Process Piping and Fittings”. Flexible connectors shall isolate vibrations and compensate for pipe misalignment, movement, and offsets.

2.14 THREADED INSULATING CONNECTIONS

A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials and shall have ratings and properties to suit the service and loading conditions.

2.15 GASKETS AND PACKINGS

A. Gaskets shall be full-faced, 1/16-inch thick compressed sheets of aramid fiber base with nitrile binder and non-stick coatings, suitable for temperatures to 700 degrees F, a pH of 1 to 11, and pressures to 1000 psig as manufactured by Garlock Style 3000 or 3400, John Crane Style 2160, or equal. Where blind flanges are shown, the gaskets shall cover the entire inside surface of the blind flanges and shall be cemented to the blind flanges. Ring gaskets shall not be permitted.

B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal", or equal.

C. Packing around rotating shafts (other than valve stems) shall be "O"-rings or similar seals or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER.

2.16 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.17 SAFETY REQUIREMENTS

A. Where work areas are located within a flammable or toxic gas environment, suitable gas detection, ventilating, and oxygen deficiency equipment shall be provided. Workers shall be equipped with approved breathing apparatus.

PART 3 -- EXECUTION

3.1 COUPLINGS

A. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations.

3.2 INSULATING CONNECTIONS

A. All insulating connections shall be installed in accordance with manufacturer's printed instructions.

**** END OF SECTION ****

SECTION 43 11 33 - BLOWER SYSTEM (POSITIVE DISPLACEMENT)

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall provide all materials, labor, and equipment to furnish and install one (1) complete set of positive displacement blower assemblies as specified herein and detailed in the drawings.

B. Blowers shall be suitable for continuous operation at the conditions stated herein without excessive vibration, heating, or any damage to the blowers. The vibration standard specified in Section 43 00 00 shall be met.

C. Blowers shall be installed on spring vibration isolators.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 24 20 - Electric Motors

B. Section 26 90 02 - System Control

C. Section 40 05 60 - Valves

D. Section 40 23 00 - Process Pipe and Pipe Fittings

E. Section 43 00 00 - Equipment General Provisions

1.3 SUBMITTALS

A. All submittals shall be in accordance with Section 01 33 00 “Submittals.”

B. Six (6) copies of submittal data will be required.

C. The following design criteria shall be included in the submittals:

1. Blower efficiency
2. Drive efficiency
3. Motor efficiency

1.4 QUALITY ASSURANCE

A. Manufacturers

1. It is the intention of these specifications to cover minimum acceptable quality equipment for a complete installation.
2. Part numbers or trade names are used in this Specification only to facilitate the description of the equipment the ENGINEER prefers to use and in no way implies that equal equipment of other manufacturers cannot be used.
3. The equipment manufacturer shall have not less than five years of experience in the design, construction, and successful operation of equipment of the type specified at five plants.

1.5 EQUIPMENT SUPPLIERS SERVICE REPRESENTATIVE

A. Installation Assistance

1. Provide installation assistance on the equipment supplied.

B. Equipment Start-up Service

1. Provide equipment start-up services on the equipment supplied by a factory-authorized technician for not less than eight (8) hours, excluding travel. Startup services shall be performed under actual operating conditions. Any startup done prior to the commissioning of the treatment facility will be considered as check-out services and will not be considered as part of the startup.

C. Operating Instruction and/or Operator Training

1. Provide one (1) eight (8) hour working day for the training of plant operators.

D. Service contract shall be given to a Service Representative located within 150 miles of the project.

1.6 GUARANTEE AND WARRANTY

A. The equipment shall be supplied with the standard warranty of the manufacturer.

B. The supplier shall unconditionally guarantee to meet the design criteria detailed in Part 2.

PART 2 -- PRODUCTS

2.1 DESIGN CONDITIONS

A. Each blower supplied shall deliver the specified airflow rate at the specified site conditions.

Blower ID	ME-A-7
Capacity	200 SCFM
Altitude	1,280 ft. above MSL
Relative Humidity	85%
Max Temperature	115°F
Min. Temperature	-20°F
Inlet Pressure Drop	0.2 psig
Discharge Pressure	7.5 psig

B. Maximum Blower Speed 1,800 rpm.

C. Blower Motor shall be 15 HP.

2.2 BLOWER CONSTRUCTION

A. Casing

1. One-piece close-grained cast iron with separate headplates.

2. Vertical arrangement of the blower, so that inlet and outlet are on opposite sides of the blower and in the same horizontal plane.

B. Impeller

1. Straight, two-lobe, involute type, balanced, carried by ball bearings on each end.

2. Timing gears shall be alloy steel or ductile iron, accurately machined, and securely attached to the impeller shaft.
3. Gears and bearings shall be splash oil lubricated. Oil shall be food-grade oil suitable for potable water use.
4. Viton oil lip seals or equal.
5. The impeller side of the oil seals shall be vented to the atmosphere to relieve air pressure on the seals.

C. Bearings

1. Anti-friction bearings, ball or roller type. Designed for a minimum life span of 70,000 hours.

D. Base

1. Common base for motor and blower, fabricated steel, reinforced to withstand normal loading.
2. Provide grout holes.

E. Inlet and Outlet Connections

1. Factory-supplied flexible connectors for both inlet and outlet with flanged connections to piping.

2.3 MANUFACTURERS OR EQUAL

A. Gardner Denver

B. Approved Equal

2.4 ACCESSORIES

A. Inlet Filter

1. Four (4) inch reusable, dry type complete with weather hood and filter restriction indicator.
2. Provide three (3) additional filter elements.
3. Filter efficiency shall be 98 percent with particles of two (2) micron-diameter and larger.
4. Pressure drop through filter shall not exceed two inches (2”) w.c. when the blower operates at full capacity.

B. Silencers

1. Discharge silencers and shall be packed absorption chamber design.
2. UCI, EM Products, or equal.
3. Designed and sized for operation conditions stated herein on each blower.

C. Pressure Relief Valve

1. Discharge, weighted-type, adjustable by selecting proper weights on each blower.

D. Valves

1. Check Valves: 125 lb., full-flanged, Technocheck, or equal, size as shown on Plans. And as specified in Section 40 05 60 Valves.
2. Butterfly Valves: Size as shown on Plans, as specified in Section 40 05 60.

E. Discharge Pressure Gauge

1. The pressure gauge shall be liquid-filled and incorporate a 4.5-inch dial size with a range of 0 to 15 PSI.

2. The blower assembly manufacturer shall mount the pressure gauge with a snubber on the outlet side of the discharge silencer.

F. Thermometer

1. Bi-metal with a three-inch (3”) dial indicating a range from 50 to 300°F installed on the discharge line of each unit. Stem Length shall be 2.5”.

G. Vibration Pads

1. Blower supplier shall supply vibration isolator pads for each blower assembly.

2.5 MOTORS AND DRIVES

A. Motors

1. Operate on 480 volts, 3 phase, 60-cycle, 1,800 rpm.

2. Comply with Section 26 24 20.

3. Horsepower: As specified in Paragraph 2.1, “Design Conditions”.

B. Provide one (1) set of extra drive belts for each drive.

C. Motors operated using Variable Frequency Drives shall meet the following requirements:

1. Specifically designed for use with a solid-state inverter variable frequency drive (VFD).

2. Minimum service factor of 1.00 when operating from a VFD.

3. 1600V insulation system designed for inverter duty.

4. Shaft grounding ring on the drive end of the motor.

5. Insulated or insulated/ceramic bearing on the non-drive end of the motor for motors 100 hp and larger.

6. Thermal switch embedded in the motor windings to open on motor over-temperature condition. Normally-closed contacts are rated 5 amps at 120 volts.

2.6 SOUND ENCLOSURE

A. Each blower shall be furnished with a sound enclosure that covers the blower and drive system completely, leaving only the motor exposed.

B. The enclosure shall be constructed of 12 gauge steel with inner layers of insulation for soundproofing. The interior must be lined with an oil-proof liner, also.

C. Provide hinged or quick release panels for access to drive sheave, drive belts, oil sight glass, and any other areas that require access.

D. Extend oil fill and drain lines through enclosure for ease of access.

E. The sound enclosure shall meet noise test requirements as specified in this section.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Piping and Base Installation

1. Blowers shall be installed, and blower bases shall be filled with concrete and grouted on concrete bases as shown on the plans.

2. Contractor shall adequately support the silencers to eliminate pipe strain on the blower casings.

3. Blowers shall be piped as shown on the plans.

B. Controls

1. Controls for the blowers are specified in Section 26 90 20 - System Control.

C. Painting

1. Equipment shall receive coatings as specified in Section 09 91 00.

D. Noise Test

1. Blower noise level shall be field-tested with the “A” scale of a USASI-approved meter at four equally spaced locations, five feet above the floor and three feet from the blowers. Each blower shall be tested with the other blower out of service.

2. Blowers shall operate at specified RPM under full load without exceeding 90 decibels. Report shall be submitted to ENGINEER. Supplier shall be responsible for making any corrections necessary to meet noise requirements.

3. If the noise level exceeds 90 dB, the Contractor shall insulate piping, fittings and the silencers to meet the noise requirement at no additional cost to the OWNER.

**** END OF SECTION ****

SECTION 43 23 00 – SELF-PRIMING CENTRIFUGAL PUMPS

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The Contractor shall furnish all labor, material, equipment, and appurtenances to install complete, and make ready for operation and field test two (2) self-priming centrifugal pumps wastewater pumps suitable for sludge loadout and supplemental mixing.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittals

B. Section 26 24 20 – Electric Motors

C. Section 26 90 01 – Measuring and Control Instrumentation

D. Section 26 90 02 – System Control

E. Section 40 73 00 – Gauges

F. Section 43 00 00 – Equipment General Provisions

1.3 SUBMITTALS

A. As specified in Section 01 33 00.

B. Product Data

1. Prior to fabrication, the stormwater pump manufacturer shall submit three (3) copies of submittal data for review and approval.

2. Submittal shall include shop drawings and support data as follows: Catalog cut sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

C. Shop Drawings

1. Shop drawings of all pumps shall be submitted for review by the City. Shop drawings shall contain the following information:

(a) Pump name, identification number, and specification number.

(b) Performance curve and pump data.

(c) The manufacturer shall indicate points on the H/Q curves, and the limits recommended for stable operation between which the pumps may be operated without surge, cavitation, and vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

(d) Pump detailed description and specification.

(e) Electrical data including control and wiring diagrams.

(f) Assembly and installation drawings, including shaft size, coupling, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

D. **O & M Instructions:** The CONTRACTOR shall provide two (2) copies of operation and maintenance manuals for each size pump. The manuals shall be prepared specifically for the equipment furnished and shall include all required catalog cut sheets, drawings, instructions, and other materials required to instruct operating and maintenance personnel in the proper use, adjustment, operation, and repair of equipment furnished.

1.4 QUALITY ASSURANCES

A. Equipment – All pumps shall be factory tested in accordance with the Test Code for Centrifugal Pumps of the Standards of the Hydraulic Institute, Inc. Tests shall be performed on the actual assembled unit from shut-off head condition to 25 percent above the required design capacity.

B. All pumps shall be field-tested after installation to demonstrate satisfactory operation without causing excessive noise, cavitation, vibration, and overheating of the bearings.

C. In the event of failure of any pump to meet any of the above requirements or efficiencies, the Contractor shall make all necessary modifications, repairs, or replacements to conform with these specifications.

D. The services of a factory representative to check the pump during and after installation shall be furnished by the Contractor.

E. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor.

1.5 WARRANTY

A. The pump manufacturer shall warrant the pump being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation, and service. The warranty shall be in published form and shall apply to all similar units. A copy of the warranty shall be placed on file with the Owner and Engineer prior to the installation of this equipment. The warranty shall be the manufacturer's standard.

1.6 REFERENCES

A. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)

1.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
2.	ANSI/AWWA C115/A21.51	Cast/Ductile Iron Pipe with Threaded Flanges
3.	ANSI 253.1	Safety Color Code for Marking Physical Hazards
4.	ANSI B40.1	Gages, Pressure, and Vacuum
5.	AWWA C508	Single Swing Check Valves

B. American Society for Testing and Materials (ASTM)

1.	ASTM A48	Gray Iron Castings
2.	ASTM A126	Valves, Flanges, and Pipe Fittings

3. ASTM A307 Carbon Steel Bolts and Studs
4. ASTM A36 Structural Steel
5. ASTM A536 Standard Specification for Ductile Iron Castings

C. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE Std 100 Standard Dictionary of Electrical Terms
2. IEEE Std 112 Test Procedure for Polyphase Induction Motors
3. IEEE Std 242 Protection of Industrial and Control Power Systems

D. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
1. NEC National Electrical Code
2. NEMA Std. MG1 Motors and Generators

E. Miscellaneous References
1. Ten-State Standards Recommended Standards for Sewage Works
2. Hydraulic Institute Std for Centrifugal, Rotary, and Reciprocating Pumps
3. ISO 9001 International Organization for Standardization

PART 2 -- PRODUCTS

2.1 MANUFACTUERERS OR EQUAL

A. Gorman Rupp

B. Cornell

2.2 PUMP OPERATION SND PERFORMANCE REQUIREMENTS

A.

Description	
Pump Tag	P-ST-1, P-ST-2
Rated Pump Speed (rpm)	1200
Capacity at Rated Speed	500 gpm at 25 ft.
Suction Lift (ft)	15
Minimum Passing Sphere Diameter (Inches)	3
Minimum Acceptable Efficiency at Design Point (%)	62
Discharge Outlet Diameter (Inches)	4
Motor H.P.	10
Explosion Proof Motor (Yes/No)	Yes
Variable Frequency Drive (Yes/No)	Yes
Liquid Pumped	Waste Activated Sludge
Max. Solids Conc.	4.0%
Type of Impeller	Non-Clog
Motor Voltage/Phase/Hertz	460/3/60

B. Pump Construction

1. Self-priming centrifugal solids-handling wet/dry prime pump capable of automatic re-priming during operation.
2. Suction and discharge flanged connections matched to system requirements.
3. Heavy-duty ductile iron casing/volute with a back-pull-out modular design allowing access to internals without disturbing suction/discharge piping.
4. Balanced semi-open impeller, ductile iron construction, shimless design, capable of passing spherical solids up to 3 inches in diameter.
5. Replaceable, self-cleaning wear plate, front-adjustable mild steel or abrasion-resistant wear plate.
6. High-strength steel shaft oversized to minimize deflection and shaft breakage across wide operating ranges.
7. Easily replaceable steel-reinforced nitrile rubber suction check valve accessible through the front cover plate.

C. Seals and bearings

1. Mechanical seal design to purge solids and grit from the seal area without external flushing.
2. Cartridge style mechanical seal with silicon carbide and external oil reservoir lubrication system.
3. Oversized heavy-duty bearings with dual lip seals and an atmospheric barrier to prevent contamination in the event of primary seal failure.

D. Priming System

1. Automatic priming system for unattended dry-priming and re-priming suction lifts without environmental water carry-over.

E. Drive and Motor Configuration

1. Horizontal frame mount with close-coupled configuration.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Pumping equipment shall be installed in accordance with the plans, or approved procedures submitted with the shop drawings unless otherwise approved by the Engineer.

3.2 ALIGNMENT

A. Equipment shall be field-tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

3.3 LUBRICANTS

A. The installation work shall include furnishing the necessary oil and grease for initial operation.

3.4 STARTUP

A. A startup report listing the voltage and the current on each motor lead, pumping rate based on the drawdown rate, breaker setting, overload heater size, and the rated full load current of each motor shall be submitted.

**** END OF SECTION ****

SECTION 43 25 00 - SUBMERSIBLE CENTRIFUGAL PUMPS (ALLOWANCE)

PART 1 -- GENERAL

1.1 SUMMARY

A. The Contractor shall receive and install fifteen (15) submersible centrifugal pumps with enclosed electric motors and all appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents.

B. Pumps described in this section shall be purchased with the Submersible Pump Allowance provided in Section 01 21 00 – Allowances. Contractor to furnish accessories and appurtenances, including guide rails, access hatches, safety grating, instrumentation and control.

C. Pump manufacturers shall provide one (1) day of service by a qualified service engineer to inspect the completed installation for lubrication, alignment, full operations, etc. The service engineer shall also instruct the appropriate personnel in the proper operation and maintenance of the equipment.

D. All manufactured materials hereinafter specified, shown in the drawings, and/or approved through the shop drawing review process shall be installed or applied in accordance with the manufacturer's directions unless specifically designated otherwise in the specifications or in the drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 50 00 - Miscellaneous Metal Work

B. Section 26 90 01 - Instrumentation

C. Section 26 90 02 - System Control

D. Section 46 31 00 - Chlorination and Dechlorination Equipment

E. Section 46 41 21 - Jet Mixing-Aeration System

1.3 SUBMITTALS

A. **Shop Drawings:** Shop drawings of all pumps shall be submitted electronically as described in Section 01 33 00 for review by the Engineer. Shop drawings shall contain the following information:

1. Pump name, identification number, and specification number.

2. Performance curve and pump data. Pumps exceeding the specified horsepower at any point on the performance curve will not be acceptable.

3. The manufacturer shall indicate points on the H/Q curves and the limits recommended for stable operation between which the pumps may be operated without surge, cavitation, and vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Pump detailed description and specification.

5. Electrical data, including control and wiring diagrams.

6. Assembly and installation drawings, including shaft size, coupling, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

7. Where pumps are installed in precast manholes, the pump supplier shall submit lift station layout drawings showing the spacing of the pumps relative to the centerline of the manhole structure and the location of the access hatch on the top slab.

B. All pumps shall be factory tested in accordance with the above specifications.

C. **Test Data** shall be electronically submitted in PDF format to the Engineer for approval prior to shipment. Prototype model tests will not be acceptable.

D. **Field Procedures:** Instructions for field procedures for installation, adjustments, inspection, and testing shall be provided prior to installation of the pumps.

1.4 SHOP DRAWINGS

A. The term “shop drawing” as used herein, shall include detailed design calculations, fabrication and installation drawings, erection drawings, lists, graphs, operating instructions, catalog sheets, data sheets, and similar items. Unless otherwise required, said drawings shall be submitted at a time sufficiently early to allow review of same by the ENGINEER and to accommodate the rate of construction progress required under the contract. The ENGINEER shall return prints of each shop drawing with his comments within 30 calendar days after receipt of shop drawings from the CONTRACTOR.

B. The CONTRACTOR shall review all the submittals before forwarding them to the ENGINEER for review. The submittals shall be in conformance with the CONTRACT DOCUMENTS, and any minor variations shall be noted in the transmittal form. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal by the second submission of drawings. The OWNER reserves the right to withhold money due to the CONTRACTOR to cover additional costs of the ENGINEER's review beyond the second submission. Shop drawings shall be submitted electronically as described in Section 01 33 00.

C. All shop drawings shall be submitted through the GENERAL CONTRACTOR and be accompanied by the ENGINEER's standard shop drawing transmittal form. All resubmittals shall include one copy of the previously rejected submittal.

D. Revisions indicated on shop drawings shall be considered as changes necessary to meet the requirements of the Contract Drawings and Specifications and shall not be taken as the basis of claims for extra work. The CONTRACTOR shall have no claim for damages or extension of time due to any delay resulting from the CONTRACTOR's having to make the required revisions to shop drawings. If the review by the ENGINEER is delayed beyond thirty (30) days, then the CONTRACTOR shall notify the ENGINEER in writing that unless the said shop drawing is returned to the contractor within three (3) business days, there may be a delay in CONTRACTOR's construction schedule.

E. The review of said drawings by the ENGINEER will be limited to checking for general agreement with the specifications and drawings and shall, in no way, relieve the CONTRACTOR of responsibility for errors or omissions contained therein, nor shall such review operate to waive or modify any provision contained in the Specifications or Contract Drawings. Fabricating dimensions, quantities of material, applicable code requirements, and other contract requirements shall be the CONTRACTOR's responsibility.

1.5 QUALITY ASSURANCE

A. Equipment - All pumps shall be factory tested in accordance with the Test Code for Centrifugal Pumps of the Standards of the Hydraulic Institute, Inc. Tests shall be performed on the actual assembled unit from shut-off head condition to 25 percent above the required design capacity.

B. All pumps shall be field-tested after installation to demonstrate satisfactory operation without causing excessive noise, cavitation, vibration, and overheating of the bearings.

C. In the event of failure of any pump to meet any of the above requirements or efficiencies, the Contractor shall make all necessary modifications, repairs, or replacements to conform to these specifications.

D. The services of a factory representative to check the pump during and after installation shall be furnished by the Contractor.

E. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor.

1.6 WARRANTY

A. The pump manufacturer shall warrant the pump being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation, and service. The warranty shall be in published form and shall apply to all similar units. A copy of the warranty shall be placed on file with the Owner and Engineer prior to the installation of this equipment. The warranty shall be the manufacturer's standard.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Flygt

2.2 PUMP OPERATION AND PERFORMANCE REQUIREMENTS

Description						
Pump Tag	P-JM-1,2,3,4	P-JM-5,6	P-MLR-1,2	P-RAS-1,2,3,4	P-SC-1	P-WW-1,2
Rated Pump Speed (rpm)	1,150	1,200	1,714	1,745	1,760	1,750
Capacity at Rated Speed	810 gpm at 18 ft.	2,000 gpm at 20 ft.	2,000 gpm at 9 ft.	325 gpm at 51 ft.	75 gpm at 39 ft.	700 gpm at 26 ft.
Minimum Passing Sphere Diameter (Inches)	3	3	3	3	3	3
Minimum Acceptable Efficiency at Design Point (%)	62	72	63	66	29	6,533
Discharge Outlet Diameter (Inches)	6	6	4	4	4	4
Motor H.P.	10	20	15	10	5	10
Explosion Proof Motor (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes
Variable Frequency Drive (Yes/No)	No	Yes	Yes	Yes	Yes	No
Liquid Pumped	Activated Sludge	Activated Sludge	Activated Sludge	Activated Sludge	Scum	Raw Wastewater
Max. Solids Conc.	0.5%	0.5%	0.5%	1.5%	1.5%	0.5%
Type of Impeller	Non-Clog	Non-Clog	Non-Clog	Non-Clog	Non-Clog	Non-Clog
Motor Voltage/Phase/Hertz	460/3/60	460/3/60	460/3/60	460/3/60	460/3/60	460/3/60

B. See Section 46 31 00 for submersible pump specifications for utility water pumps associated with the chemical feed systems (P-UW-1 and P-UW-2).

2.3 PUMP CONSTRUCTION

B. Pumping units shall be of the centrifugal, non-clog submersible type. The design shall be such that pumping units will be automatically connected to the discharge piping when lowered into place on the discharge connection. The pumps shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be removed for this purpose, and no need for personnel to enter the wet well. Each pump shall be fitted with a stainless-steel chain of adequate strength and length to permit raising the pump for inspection and removal.

C. Pump casting, pump discharge elbow, and impeller shall be Class 30 or 40B cast iron. The pump volute shall be a non-concentric design. All exposed nuts and bolts shall be of stainless steel 304. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease, or other devices shall be used.

D. All surfaces coming into contact with sewage, other than stainless steel, shall be protected by an approved sewage-resistant coating.

E. The pump shaft shall be ASTM A276, Type 420 stainless steel, or ASTM A576, Grade 1045 carbon steel. The carbon steel pump shaft shall not be exposed to the pumped liquid and shall be protected and completely isolated by an ASTM A276, Type 420 stainless steel.

F. Each pump shall be provided with a tandem mechanical rotating shaft seal system. Seals shall run in an oil reservoir. The lower seal unit, between the pump and oil chamber, shall contain one stationary and one positively driven rotation tungsten carbon and ceramic. The upper seal unit, between the oil sump and motor housing, shall contain one positively driven rotating carbon ring. Each interface shall be held in contact by its own spring system.

G. The seals shall not require maintenance or adjustment but shall be easily inspected or replaceable. No seal damage shall result from operating the pumping unit out of its liquid environment.

H. The pump shall be equipped with a seal leak detection probe and warning system designed to alert maintenance personnel to lower seal failure.

I. There shall be an electric probe installed in the seal chamber between the two tandem seals. The probe shall be designed to sense contaminants within the seal chamber and send a signal to operate a warning device.

J. The following seal types shall not be considered acceptable or equal to the dual independent seal specified:

   1. Rotating shaft seals that are not clipped or set screwed to the shaft.

   2. Conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units.

   3. Seals that require a pressure differential to offset external pressure to affect the sealing.

K. Each pump shall be provided with an oil chamber for the shaft sealing system. The drain and inspection plug, with a positive anti-leak seal, shall be easily accessible from the outside.

L. The pump shaft shall rotate on two (2) permanently greased lubricated bearings.

M. The impeller shall be of gray cast iron, Class 30 or Class 40B, double shrouded clog-inhibiting type characterized by a constant area throughlet. The impellers must be hydraulically and dynamically balanced to run “vibration-free” in air and water. The impeller design shall be as indicated in the pump schedule above. The fit between the impeller to the shaft shall be made by a locking assembly

which is perfectly sealed from the liquid by a protective rubber cap, and a bolt threaded to the shaft terminal.

N. A rotating wear ring system shall be installed to provide sealing between the volute and impeller. The stationary volute and rotating impeller wear ring shall be stainless steel.

O. The pump discharge size shall be such that the exit velocity shall not exceed 12 ft./sec. at the rated pump capacity. The use of increasing elbow to reduce the velocity will not be acceptable. Pumps manufactured unable to meet the maximum velocity specified shall use a lower RPM pump to meet the maximum velocity criterion. **Using hardened elbows will not be acceptable.**

2.4 PUMP MOTOR

B. Equipment requiring electric motors shall be equipped with motors conforming to the following unless specifically noted otherwise.

1. The motor furnished shall have its design voltage inscribed on the nameplate.

2. All motors less than 30 HP shall be designed, constructed, and tested in accordance with NEMA Standards MG1 1972 and MG2 1973.

C. The pump motor cable shall be S.P.C. suitable for submersible pump applications. The power cable shall be sized according to NEC and ICDA standards and have P-MSHA approval. The pump cable end will be sealed with a protective covering prior to electrical installation. The cable shall be continuous from the motor to the control panel. No splicing will be permitted.

D. Design cable entry with a machined precision fit. It shall preclude specific torque requirements to ensure a watertight and submersible seal. Do not use epoxies, silicones, or other secondary sealing systems.

E. The junction chamber containing the terminal board shall be sealed from the motor by an O-ring seal. The connection between the cable conductors and stator leads shall be made with a threaded compressed type binding post permanently affixed to a terminal board and thus perfectly leakproof.

1. The pump motor shall be squirrel-cage, induction, shell-type design, air-cooled, NEMA Design B. Motor shall be explosion-proof, suitable for use in Class 1, Division 1, Group C& D hazardous locations. The stator winding and stator leads shall be insulated with moisture-resistant Class F insulation, which will resist a temperature of 311°F. The motor shall be designed for continuous operation in a totally, partially, or non-submerged condition. The pump shall be capable of sustaining a minimum of ten (10) starts per hour. All three-phase motors shall be dual voltage. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches embedded in the end coils of the stator windings (one switch in each stator phase). These shall be used in conjunction with a supplement to the external motor over protection and wired to the control panel. If separate leakage sensors are provided, contractors shall be responsible for wiring those sensors.

2. Pump Protection Features: Thermal overload in each pump that will de-energize the pump starter and allows for automatic restart when the condition clears. The control panel shall contain relays for monitoring pump seal failure conditions. Coordinate equipment and circuitry requirements with the pump supplier. Input alarms to the pump controller. Seal failure alarms shall not shut down the associated pump.

2.5 ACCESSORIES

B. Pump Guide Rails and Discharge Connections

1. The Contractor shall furnish and install a complete set of guide bars designed to permit the raising and lowering of pumps. Guide bars shall be Schedule 40, 304 stainless steel pipes. Each pump shall ride on two guide bars. Pumps with only one guide bar will not be accepted. The guide bars shall be of adequate length to extend from the lower guide holders on the pump discharge connections to the upper holders. Intermediate stainless-steel supports shall be installed at intervals not to exceed ten (10) feet. Pumps with guide cables will not be acceptable.

2. The Contractor shall furnish and install the required discharge connections in each lift station, each consisting of a discharge elbow connected to a mounting base, which will be permanently installed in the lift station. Sealing the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump unit. The entire weight of the pump unit shall be guided by no less than two guide bars and pressed tightly against the discharge connection elbow with cast-iron-to-cast-iron contact. The guide bars or cables shall not support any portion of the weight of the pump. Sealing of a discharge interface by means of a diaphragm, O-ring, or another device will not be acceptable. No portion of the pump shall bear directly on the floor of the sump. The pump, with its appurtenances, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

3. The accessories shall include a stainless steel upper guide bar holder, cable rack, stainless steel hook to attach the pump lifting gear when not in use, and intermediate stainless-steel guide bar supports. Lower guide bar holders shall be integral to the discharge connection.

C. Access Hatches

1. As specified in Section 05 50 00 - Miscellaneous Metal Work.

D. Safety Grating

1. As specified in Section 05 50 00 - Miscellaneous Metal Work.

PART 3 -- EXECUTION

3.1 INSTALLATION

B. Pumping equipment, including guide rails or cables and discharge connections, shall be installed in accordance with the plans, or approved procedures submitted with the shop drawings unless otherwise approved by the Engineer.

C. CONTRACTOR shall demonstrate the removal of each submersible pump in the presence of the ENGINEER to ensure proper installation of the pumps, lifting chains, guide rails/cables, electrical wiring, and hatches.

3.2 ALIGNMENT

B. Equipment shall be field-tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

3.3 LUBRICANTS

B. The installation work shall include furnishing the necessary oil and grease for initial operation.

3.4 STARTUP

B. A startup report listing the voltage and the current on each motor lead, pumping rate based on the wetwell drawdown rate, breaker setting, overload heater size, and the rated full load current of each motor shall be submitted.

**** END OF SECTION ****

SECTION 46 21 13 - MECHANICAL FINE SCREEN

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The Contractor shall furnish and install, as shown on the plans, a fully automatic mechanically cleaned fine screen, complete with all accessories.

B. The equipment furnished shall positively clean and remove debris from incoming sewage by means of a moving perforated plate that retains the debris. The screen shall be cleaned by engaging the mechanism and at the channel invert to remove debris on its upward travel.

C. The mechanical screen mechanism shall be designed so there are no chains, sprockets, bearings, shafting, or other moving parts permanently below the liquid surface of the channel at maximum daily flow. This design shall also ensure that all maintenance to the mechanism can be accomplished at the operating floor level. Units with drives and motors which cannot be maintained from the operating level shall be provided with platforms and stairways, including handrails and kick plates.

D. Compliance submittals shall include detailed dimensional drawings which verify the equipment will conform to the layout as shown on the contract drawings. Particular emphasis shall be given to discharge elevation and to the elevation of the drive head with adequate allowances indicated for maintenance operations. Any revisions in structural design to accommodate the screen equipment shall be the responsibility of the Contractor.

E. All electrical equipment shall be explosion-proof.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 05 50 00 - Miscellaneous Metals

C. Section 26 24 20 - Electric Motor

D. Section 26 90 01 - Instrumentation

E. Section 26 90 02 - System Control

F. Section 43 00 00 - Equipment General Provisions

1.3 SUBMITTALS

A. Shop drawings shall be submitted to the ENGINEER in accordance with Section 01 33 00 and shall contain the following information as a minimum:

1. Dimensional drawings.

2. Layout drawings to confirm that there are no conflicts with the layout shown on the contract drawings.

3. Electrical data including control wiring.

4. Assembly and installation drawings.

B. **O & M Manuals:** The CONTRACTOR shall provide four (4) copies of O & M manuals which shall include: part nomenclature, material list, and other materials required to instruct operating and maintenance personnel in the proper use, adjustment, operation, and repair of equipment furnished.

C. **Field Procedures:** Instruction for field procedures for installation, adjustments, inspections, and testing shall be provided prior to the installation of equipment.

1.4 QUALITY ASSURANCES

A. The screen manufacturer shall provide one day service by a qualified service engineer to inspect the completed installation for lubrication, alignment, free operations, etc., and to instruct the appropriate personnel in the proper operation and maintenance of the equipment.

1.5 WARRANTY

A. The screen manufacturer shall warrant the equipment against defects in workmanship and materials for a period of two (2) years from the date of the startup. A copy of this warranty shall be placed on file with the OWNER or ENGINEER prior to the installation of equipment.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS OR EQUAL

A. Parkson

B. Huber

2.2 GENERAL DESCRIPTION

A. The mechanically-cleaned screen shall be free-standing and anchored as required for installation and operation in the 24” wide flow channel shown on the plans. The screening area shall encompass the entire channel width. The mechanically cleaned screen shall consist of a frame, perforated plate, spray wash system, enclosure, and drive assembly.

B. The screen shall be capable of passing a maximum of 2.0 MGD of raw sewage with a maximum water depth of 48” in a channel 24” wide. The normal flow rate shall range between 0.5 MGD and 1.6 MGD. The loss of head at maximum flow rate shall not exceed 5” of water, and the screen shall present a clean surface to the oncoming water stream after each operation cycle.

2.3 MATERIALS

A. The main frame and housing shall be constructed of 304 stainless steel unless otherwise noted in these specifications.

B. The screen shall consist of a ¼”perforated plate linked to form a continuous filter belt.

C. Frame and guide channels shall be made of 304 stainless steel. The frame shall be assembled to make a rigid framework that, when properly anchored in accordance with the manufacturer's instructions, will withstand all the forces encountered by the installation.

D. The discharge chute shall discharge a minimum of 4'-0” above the floor level and free-fall into the screenings container or screenings washer/compactor.

E. The drive assembly shall be complete high-strength roller chains driven by a common shaft sprocket and flanged mounted gear motor. A forward-off-momentary reverse switch suitable for operation in Class I, Group D, and Division 2 locations shall be provided.

F. Submerged bearings shall be maintenance-free, wear-resistant ceramic bearings designed to tolerate gravel and grit.

G. A 304 stainless steel enclosure with easily removable covers shall be provided to fully encase the screen and reduce odors.

H. The mechanical screen shall be equipped with an internal spray nozzle bar, counter rotating brushes, and an overload protection system.

I. The screen shall make a complete cycle and discharge all screenings after deactivation of the “auto” mode control signal as specified in Section 26 90 02 of these specifications.

2.4 ELECTRICAL CONTROLS

A. Electrical components and controls shall be provided with a NEMA 4X stainless steel enclosure.

2.5 SCREENING CONTAINER

A. The Contractor shall furnish two (2) 30-gallon heavy-duty plastic garbage cans, which are of the appropriate height to accommodate the discharge chute.

2.6 PAINTING

A. Refer to Section 09 91 00 concerning the preparation and painting of the screens.

B. All gearboxes, primer, motors, and controls shall have the manufacturer's standard machinery paint finish.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with the manufacturers’ instructions.

B. Test equipment for proper installation and make necessary repairs and adjustments for complete and proper operation.

**** END OF SECTION ****

SECTION 46 21 73 - SCREENINGS DEWATERING PRESS

PART 1 -- GENERAL

1.1 GENERAL

A. The Contractor shall furnish and install, as shown on the plans, a fully automatic screenings dewatering press, complete with all accessories.

B. The equipment furnished shall be capable of dewatering solids entering the press with an 8-12% dry solids level and discharge solids at a 30-35% dry solids level at a feed rate of 2-2.5 cubic feet per hour.

C. Screenings dewatering press and the mechanical bar screen specified in Section 46 21 13 shall be supplied by the same manufacturer.

1.2 RELATED SECTIONS

A. Section 01 33 00 – Submittals

B. Section 46 21 13 – Mechanical Fine Screen

PART 2 -- PRODUCTS

2.1 EQUIPMENT DESCRIPTION

A. The press shall be of screw design, with an internal screw having a maximum pitch equal to the screw outer diameter. The screw shall be supported on heavy-wearing strips integral with the press body.

B. The integral inlet hopper shall be sized to collect the screenings from the fine screen being supplied. Spillage of screenings will not be acceptable. A removable maintenance cover shall be furnished to allow access to the effluent port for inspection or cleanout. The height of the inlet hopper shall not exceed 2’-0” above the curb elevation to match the discharge height of the bar screen as shown in the drawings.

C. The press discharge shall have a diameter of 6 inches and incorporate an adjustable choke nozzle to accommodate variations in feed density and to provide maximum dewatering of the screenings.

2.2 MATERIALS

A. The entire screenings dewatering press shall be 304 stainless steel. This shall include but not be limited to the screw, inlet hopper, screw housing, discharge choke nozzle, external support members, anchoring hardware, and other appurtenances.

B. The screw shall be driven by a direct-coupled, shaft-mounted, right-angle, heavy-duty worm gear motor. The motor shall be 1-1/2 HP, 1800 RPM, 480 volts, 3-phase, 60-cycle, explosion-proof, and in conformance with NEMA standards, suitable for Class I, Group D, Division 1 location, and shall conform to the requirements of Section 26 90 02 of these specifications.

C. The screenings dewatering press shall be equipped with an overload protection system which will stop the unit when an over-torque level is reached. The torque device shall be of the limit switch or electric torque-sensing type. The torque device shall automatically reset when the over-torque condition is corrected. On power failure, manual resetting of the torque device shall not be required.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Install screenings dewatering press as recommended by the Manufacturer.

3.2 PAINTING

A. Refer to Section 09 91 00 concerning the preparation and painting of the bar screen.

B. All gearboxes, motors, and controls shall have a manufacturer's standard primer finish.

3.3 FIELD SERVICE

A. The screen manufacturer shall provide one-day service by a qualified service engineer to inspect the completed installation for lubrication, alignment, free operations, etc., and to instruct the appropriate personnel in the proper operation and maintenance of the equipment.

**** END OF SECTION ****

SECTION 46 30 00 - CHEMICAL FEED EQUIPMENT, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install all chemical feeding equipment shown and specified, complete with metering and transfer pumps, tanks, motors, drives, mixers, feeders, meters, conveyors, control panels, piping, valves, controls, and accessories to transfer, dilute, mix, and feed chemicals and solutions, complete and operable, all in accordance with the requirements of the Contract Document.

B. All equipment and items furnished shall be from manufacturers with several years of experience in the manufacture and assembly of similar products, with a record of successful installations. Such manufacturers shall maintain a well-established, authorized, local service agency with sufficient spare parts and personnel to respond within 48 hours to any service calls.

C. The CONTRACTOR is to furnish and install the following chemical feed systems:

1. Chlorination and Dechlorination Equipment
2. Corrosion Inhibitor/Polyphosphate Feed System

D. **Unit Responsibility:** The CONTRACTOR shall assign a single supplier full responsibility for the furnishing and functional operation of the chemical feeder systems along with all related tanks, mixers, pumps, chemical feed piping, tubing, valves, analyzers, and controls. The designated single Supplier, however, need not manufacture more than one part of the system but shall coordinate the design, assembly, testing, and erection of the system as specified herein.

E. The Chemical feed supplier shall submit detailed layout drawings of the equipment supplied. No installation shall begin before the layout drawings are approved. The drawing shall identify the components supplied by the supplier and the components supplied by the Contractor, and all items which require electrical power and signal wires. An equipment supplier visiting the job site to locate the equipment in lieu of providing the layout drawings will not be acceptable.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Division 22 - Plumbing

B. Section 26 90 01 - Measuring and Control Instruments

C. Section 26 90 02 - System Control

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes:

International Building Code (IBC)

ANSI/NFPA 70-2011 National Electric Code

1.4 SUBMITTALS

A. **Shop Drawings:** Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, power drive assemblies, parts, devices, pumps, tanks, mixers, supports, panels, and other accessories, forming a part of the equipment

furnished as well as schematics, diagrams, and panel layouts, shall be submitted for review in accordance with Section 01 33 00 “Submittals”. Submittal shall include control-wiring diagrams for interfacing with equipment supplied under Section 26 90 02 - System Controls.

B. **O & M Manuals:** Prior to start-up, the CONTRACTOR shall furnish to the OWNER complete operations and maintenance manuals in accordance with Section 01 33 00, “Contractor Submittals”.

C. **Tools:** Special tools necessary for maintenance and repair of the equipment shall be furnished as a part of the WORK hereunder; such tools shall be suitably stored in metal toolboxes and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

D. **Spare Parts:** The CONTRACTOR shall obtain from the manufacturer a list of suggested spare parts of all items of each piece of equipment subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, wear rings, etc., as well as a set of spare bearings. He shall furnish all these parts suitably packaged and labeled in a box as described above for tools.

E. **Maintenance:** Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units. A recommended spare parts list shall be included.

F. **Field Procedures:** Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of the equipment.

G. **Calibration Graphs:** The supplier’s representative shall prepare a calibration graph from field tests for each chemical feed unit that does not have a rate set device reading in gallons per hour for liquid feeders. The graph shall show the rate setter graduation conversion to gallons per hour throughout the range of the feed unit. Each graph shall be furnished on hard paper and sealed in clear plastic.

1.5 MANUFACTURER’S SERVICE REPRESENTATIVE

A. **Erection and Startup Assistance:** Service and instruction assistance by the manufacturer’s engineering representative for each equipment unit shall be provided by the CONTRACTOR during the following period:

1. One day during erection, unless otherwise specified.

2. One day during startup, unless otherwise specified.

B. **Instruction of Owner’s Personnel:** The CONTRACTOR shall provide for the services of a factory service representative to instruct the OWNER’s personnel in the operation and maintenance of the equipment. This service shall consist of a minimum of one day visit to the plant for each type of similar equipment.

1.6 CLEANUP

A. After completion of the installation and testing, the CONTRACTOR shall remove all debris from the site, clean all the equipment and controls, and hand over his work in perfect operating condition.

1.7 GUARANTEES, WARRANTIES

A. After completion, the CONTRACTOR shall furnish to the OWNER the manufacturer’s written guarantees that the equipment will operate with the published efficiencies, heads, criteria, and flow ranges and meet these specifications. The CONTRACTOR shall also furnish the manufacturer’s warranties as published in their literature and as specified.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Wherever it is specified that a single manufacturer shall be responsible for the compatible and successful operation of the various components of any equipment unit, it shall be understood to mean that the CONTRACTOR shall furnish and install only such equipment as the designated manufacturer will certify is suitable for use with its equipment and with the further understanding that this in no way constitutes a waiver of any specified requirements.

B. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

C. Where two or more units of the same type and/or size of equipment are required, such units shall all be produced by the same manufacturer.

2.2 MATERIALS

A. **General:** All materials employed in the equipment shall be suitable for the intended application; materials not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

B. **Corrosion Resistance:** All materials used in the construction of chemical feed equipment shall be resistant to corrosive attacks from the chemicals they serve.

2.3 APPURTENANCES

A. **Nameplate:** Each piece of equipment shall be equipped with a stainless steel nameplate indicating equipment characteristics, capacity, motor horsepower, speed, electrical characteristics, manufacturer, model number, and serial number.

B. **Solenoid Valves:** The equipment manufacturer shall furnish and install all solenoid valves which are part of the chemical feeding unit. The solenoid valve electrical rating shall be compatible with the equipment voltage, and valves shall be furnished complete with the necessary conduit and wiring from the control panel to the solenoids. The valve material shall be suitable for the intended service in accordance with Section 40 05 60 “Valves” and Division 22 - Plumbing.

C. **Pressure Gauges:** All chemical transfer and metering pumps, and other equipment, where shown, shall be equipped with pressure gauges with diaphragm seals in accordance with the spec section entitled “Gauges”, except that the size of gauges on small metering pumps may be smaller than specified in the above section.

D. **Safety Equipment:** Where required by Code, all chemical unloading, storage, and feeding equipment shall be furnished with the necessary safety devices and warning signs, clearly visible.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Chemical feeding equipment shall be installed in accordance with governing safety standards and approved procedures submitted with the shop drawings and as indicated in the drawings unless otherwise approved by the ENGINEER.

B. Chemical feed tubing of appropriate size and material for each material shall be installed in a 3-inch Schedule 80 carrier pipe. Carrier pipe shall be field routed from the chemical feed to the application point. All carrier pipe shall be painted to match industry standard coloring.

C. **Alignment:** Equipment shall be field-tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Driveshafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

D. **Lubricants:** The installation work shall include furnishing the necessary oil and grease for initial lubrication and testing of all equipment.

3.2 PAINTING

A. All exposed materials, except corrosion-resistant metals which have not been shop-painted, shall be field coated as specified in Section 09 91 00 “Painting”. Shop painted items which suffered damage to the shop coating shall be touched up as specified in “Painting” section.

**** END OF SECTION ****

SECTION 46 31 00 - CHLORINATION AND DECHLORINATION EQUIPMENT

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install chlorination and dechlorination equipment as shown on plans and shall provide a complete and operable system.

B. The system shall include the following as a minimum:

1. Chlorinator system with automatic switchover and appurtenances.
2. Sulfonator system with automatic switchover and appurtenances.
3. Ejectors.
4. Remote-mounted diffusers.
5. Scales.
6. Vacuum tubing, Y-strainers, pressure gauges, pressure regulating valves, and all other miscellaneous items to make an operative system.
7. Submersible solution water pumps.
8. Chlorine and sulfur dioxide gas detectors.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 26 05 00 - Common Work Results for Electrical

C. Section 26 90 01 - Instrumentation

D. Section 26 90 02 - System Control

E. Section 40 05 60 - Valves

F. Section 40 23 00 - Process Piping

G. Section 43 00 00 - Equipment General Requirements

1.3 SUBMITTALS

A. **Shop Drawings:** Shop drawing submittal shall include complete assembly and installation drawings and detailed specifications, including material of construction for all components.

B. **O & M Manual:** The manufacturer shall provide four (4) copies of an O & M Manual for each system.

1.4 QUALITY ASSURANCES

A. **Field Service:** The chlorination/dechlorination equipment supplier shall provide one (1) day of service by a qualified service engineer to inspect the completed installation and to instruct the OWNER's operating personnel in the proper operation and maintenance of the equipment.

B. **Certification:** Upon completion of installation and prior to final acceptance, the CONTRACTOR shall submit a certification of installation signed by the manufacturer to certify that the equipment has been installed properly.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS OR EQUAL

A. Hydro-Instruments

B. Wallace & Tiernan

2.2 CHLORINE AND SULFUR DIOXIDE SYSTEM AND APPURTENANCES

A. Complete and operative gas feed systems, as described below, shall be furnished and installed as shown on the plans. The automatic switchover gas system shall be of the vacuum operated, continuous feed type, dispensing gas to the ejector and automatically switch the gas supply from an empty source to a full source. Each gas system shall have a design capacity of 100 pounds per day of gas feed and shall be equipped with a gas flow meter of 50 pounds of gas fed per day. All materials of construction shall be suited for the specific application. The plant effluent chlorine feed shall be varied in proportion to the plant effluent flow rate. The chlorine feed to the return activated sludge line and the sulfur dioxide feed to the plant effluent shall be controlled manually.

B. Each gas system shall be comprised of the following: two (2) vacuum regulators, pressure relief valve, gas supply indicator, automatic switchover valves or capability in the vacuum regulators to affect automatic switchover, wall-mounted gas flow meter, and automatic and manual rate valves, and miscellaneous chlorine and sulfur dioxide gas and solution feed lines and PVC ball valves as shown on the plans.

C. Each chlorinator and Sulfonator vacuum regulator shall mount directly on 150-pound containers by means of a positive yoke-type gasket connection. The vacuum shall be controlled by a spring-opposed diaphragm regulator, which shall close tight upon loss of vacuum.

D. The remote gas flow meter and manual rate valve shall be designed for use with chlorine or sulfur dioxide and shall be mounted on a chemical-resistant panel for wall mounting. The gas flow meter shall have a capacity of 100 pounds per day and indicate the flow of gas to a minimum of 1/20 maximum feed. The number of rate control valves and flow meters for chlorination and sulfonation shall be as shown in the drawings.

E. Pressure shall be prevented from building up in the system by means of a spring-loaded, diaphragm-activated pressure relief valve located at the vacuum regulator. The gas shall vent to the outside of the chlorination/dechlorination building.

F. The automatic switchover module shall be vacuum operated, switching from an empty gas source to a full source. There shall be no manual reset required when a switchover has been made and the empty container replaced with a full container. The switchover module shall be factory set and shall not require field adjustment.

G. A gravity-actuated loss of gas indicator shall be provided on each gas control unit. A switch shall also be provided that will be actuated when a loss of gas supply occurs. The switch shall actuate an external circuit consisting of an amber light mounted on the wall of the chlorine feed room.

2.3 EJECTOR WITH REMOTE DIFFUSER

A. The ejector/diffuser shall feed a chlorine or sulfur dioxide solution to the application points shown on the plans. The ejectors shall be capable of providing a 100 ppd feed rate of chlorine or sulfur dioxide

in a water solution when operating at a back pressure of 10 psig with a water supply not exceeding 15 gpm at a maximum pressure of 60 psig. A loss of water supply shall automatically shut off the gas flow, and the ejector shall be designed to prevent siphoning. The ejector shall be mounted as shown on the plans. If ejectors require a higher flow rate, larger capacity booster pumps shall be supplied at no additional cost to the OWNER.

B. Two (2) remote-mounted chlorine diffusers shall be mounted in the inlet of the chlorination basin. Two (2) sulfur dioxide diffusers shall be mounted in the outlet of the chlorination basin. The diffusers shall be universal-type, providing a spray outlet, and shall be sized to handle the 100 ppd feed rate of chlorine or sulfur dioxide.

C. A chlorine ejector with a solenoid valve shall be provided to feed chlorine to the return activated sludge (RAS) wet well. The ejector assembly shall be provided with a check valve to prevent reverse flow. The water supply pressure will be 60 psig, and the back pressure will be 10 psig. If the pressure differential is not adequate to feed 50 lbs/d, a booster pump shall be supplied with an associated electrical connection at no additional cost to the OWNER. A loss of water supply shall automatically shut off the gas flow, and the ejector shall be designed to prevent siphoning. The ejector shall be mounted as shown on the plans.

2.4 CYLINDER SCALES

A. Two (2) dual 150 lb. cylinder scales shall be furnished and installed. The scales shall be electronic dual-platform scales with a gross capacity of 0-350 pounds on each platform. The scales shall be 120 VAC, 60 Hz, single-phase, and have a 0.5% accuracy based on gross weight capacity. The display shall be a large character LCD with units of pounds. Electronics shall be enclosed in a NEMA 4X enclosure. All exposed components shall be either stainless steel or coated with polyurethane. The scale shall include safety chains and shall be Wallace and Tiernan Series, Floquip Model DR-150-2, or equal.

2.5 SUBMERSIBLE SOLUTION WATER PUMPS (UTILITY WATER PUMPS - P-UW-1, P-UW-2)

A. Submersible centrifugal type solution water pumps shall be installed as shown on the plans.

B. The pump shall match with the chlorination and sulfonation equipment supplied. The maximum operating speed of the pump shall be less than 3600 rpm.

C. Each pump shall be furnished with a 3 hp (maximum), 3600 rpm (maximum) motor. The motor shall conform to the requirements of Section 26 24 20 Electric Motors.

D. Each pump shall be supplied with 25 feet of three (3) conductor submersible power cables with a ground for connection to a circuit breaker.

E. The pump shall be suitable for handling the type of solids encountered in a typical waste effluent and shall be of submersible, non-clog design with tandem oil-filled seals.

F. The pump casing and impeller shall be cast iron and designed to provide sufficient head and capacity to overcome the friction loss within the manifold assembly and to produce the required velocity through the ejector.

G. All anchor bolts and hardware required to install the equipment in the basin shall be supplied by the equipment manufacturer. Anchor bolts and hardware shall be 316 stainless steel.

H. **Painting:** Pump shall be primed with 3 mils Tnemec 66-1211 Epoxyline Primer and then coated with 4 mils of 66 Hi-Build Epoxy]

2.6 CHLORINE AND SULFUR DIOXIDE GAS DETECTORS

A. **General:** The gas detection equipment shall consist of one chlorine sensor/transmitter, one sulfur dioxide sensor/transmitter, and a receiver or receivers for displaying and alarming any gas leakage or buildup, an alarm horn, and flashing red light, and all interconnecting wiring and miscellaneous hardware.

B. Sensors

1. The toxic gas sensors shall be electrochemical gas diffusion sensors designed to measure gas concentrations over the following ranges:

   Chlorine sensors: 0 - 10 ppm

   Sulfur dioxide sensors: 0 - 25 ppm

2. The sensors shall be maintenance-free and not require the use of a sample pump or regular changing of membranes or electrolytes in order to operate. In the presence of chlorine or sulfur dioxide, the respective sensor units will develop a current flow that will be transmitted through electrical wiring to the gas detector receiver. If transmitters are used at the sensor to amplify or condition the signal, they shall be loop-powered devices.

3. The sensors shall be wall-mounted and contained in a corrosion-resistant enclosure.

C. Receiver

1. A multi-channel receiver shall be provided to accept and process the signal from each sensor and display the output. The receiver shall be wall mounted in a NEMA 4X corrosion-resistant enclosure.

2. The gas concentration shall be displayed on a LED digital or bar graph display with automatic range change for the gas being measured.

3. The receiver shall allow for automatic or manual display scanning of the sensor inputs.

4. Two adjustable alarm setpoints shall be provided for each gas. The alarm setpoints shall be displayed when the associated sensor switch on the front panel is pressed. Setpoints shall be adjustable from 5-100% of the range.

5. An output shall be provided for each setpoint. The warning output shall be non-latching, and the high alarm output shall be latching and resettable from the front panel.

6. A horn output shall operate in conjunction with the alarm output and shall be silenced by a reset button on the front panel.

7. Contact closures shall be provided for separate warning and alarm circuits which shall actuate an external alarm horn and flashing red light mounted on the exterior of the chlorine building.

8. A light on the front panel shall indicate a malfunctioning condition.

9. The detector shall be powered by 120 VAC, 60 Hz, single-phase current.

D. Manufacturer or Equal

1. Enterra Instrumentation Technologies

2. Capital Controls Company

2.7 EMERGENCY SHUTOFF SYSTEM

A. Scope

1. This specification describes the Series CR-1Y Emergency Shutoff System for Chlorine Cylinder and Ton container valves as manufactured by Halogen Valve Systems, Inc. These systems are designed for installation in conjunction with automatic switchover systems (provided by others) that employ two chlorine containers to provide an uninterrupted flow of chlorine.

B. Description

1. The emergency shut-off system shall be comprised of two (2) electrically driven actuators that act directly upon the cylinder or ton container valve stem. The actuators shall mount upon the cylinder or ton container valve and yoke assemblies by means of a clamping mechanism and a valve stem coupling so as to be removable during cylinder changes.

2. The actuator shall deliver 40-50 Ft.-Lb. of closing torque to the valve stem upon receipt of a shutdown signal. The actuator shall be powered only in the closing direction with provision for manual override in either the open or closed direction. Power for the actuator shall be supplied by an uninterruptable 12-volt battery power supply and control system.

C. Actuator Design

1. Each actuator shaft shall couple to the valve stem and provide an extension through the actuator such that a standard chlorine wrench may be applied to the extension to manually operate the valve while the actuator is in place. The extension shaft shall be coupled to the drive motor and reduction gearing by means of a one-way, positive engagement clutch that may be selectively disengaged for manual operation. Pushing in on the shaft shall disengage the clutch for manual operation of the valve. The clutch shall have a toggle mechanism such that it remains disengaged, free to rotate in either direction, for manual operation. The clutch shall automatically reengage, for automatic closure upon activation of the motor and gear train.

D. Actuator Components

1. Motor Driver

(a) Motive power for the actuators shall be provided by 12-volt DC electric motors acting through a gear reduction system.

2. Clutch & Shaft

(a) The Actuator shall be constructed of materials suitable for the chlorine environment. The valve stem extension shaft shall be machined from a single piece of Monel. The valve stem connection coupling and shaft bearing/seal shall be of Aluminum-Silicon Bronze, C-642 Teflon coated for additional corrosion resistance. The valve stem engagement spring shall be of heat-treated Hastelloy C-276.

3. Valve Stem Coupling

(a) The element that couples the driven shaft to the valve stem shall be designed to accommodate slight misalignment of the Actuator shaft with the axis of the valve stem without restricting rotation.

4. Clamp/Frame

(a) The clamping mechanism for yoke mounting shall require no tools for installation on the valve and valve yoke.

(b) Adapters shall be available to unitize the Actuator with regulator clamping systems commonly used in the industry. Regulator mounting shall require only an adjustable wrench for mating to the regulator. The regulator manufacturer is to be specified.

(c) All clamp and frame components shall be coated with fusion-bonded polyester for corrosion resistance.

5. Sealing Devices

(a) Shaft entrances to the Actuator mechanism shall be sealed with double "O" ring seals of Viton and/or Teflon. The motor canister and main enclosure will be sealed with static Viton "O" ring seals.

E. Control Panel Design

1. The Duplex control panels shall be contained within a single electrical enclosure of NEMA 4X rating. All cables, connectors, switches, and fittings shall be of a similar rating to resist the chemical environment. Each actuator shall have a dedicated power source (battery) and microprocessor controller. Electrical power shall be delivered to each Actuator by means of a flexible cable. Each individual control panel shall have indicator lights to display the status of key system elements. The control panel shall accept signals from sources such as gas detectors, remote station alarms, seismic or fire sensors, and manual switches to trigger the Actuator to automatically close one or both of the cylinder or ton container valves. The panel shall have the capability of accepting input signals to initiate either simultaneous or independent operation of each Actuator and valve.

F. Control Panel Components

1. Control Circuitry

(a) An electronic circuit board in the control panel shall contain a microprocessor programmed to precisely control the valve closing cycle and the torque applied to the valve stem. The microprocessor shall also monitor and display the status of the battery, charging power, and system readiness as well as provide a diagnostic system check during the test cycle. Electro-mechanical relays or contacts, which are susceptible to corrosion failure, shall not be used in the control circuitry. The entire control system shall be comprised of encapsulated solid-state devices.

(b) In the event of a sustained loss of charging power (seven to ten days), the microprocessor shall detect a declining battery charge to initiate Actuator closure while sufficient power remains to apply the specified torque to the valve stem.

2. Battery and Charger

(a) The batteries shall be of the gel-cell lead-acid type rated at 7 ampere-hours. Each charging system shall provide a variable controlled charge current that is temperature compensated to optimize battery performance and service life.

3. Status Lights

(a) The control panel enclosure shall have a window in the front cover through which the operator may observe the status lights. The status lights for each respective system are as follows:

(1) **Charge Power** – (Normally On) Green to indicate that charging power is available.

(2) **Armed/Ready** – (Normally On) Rapidly pulsating Green to indicate the microprocessor is functioning and ready to operate. Flashing Green during operation and for a 15-second reset period after activation.

(3) **Battery Low** – (Normally Off) Flashing red to indicate that the battery should be replaced.

4. Input Signals

(a) The control panel shall contain a terminal strip to accept multiple incoming signals for either simultaneous or individual Actuator operation. External signals shall consist of a “Normally Open” dry contact and closure to initiate the Actuator.

5. Output Signal

(a) Upon initiation of the Actuator, the control system shall provide an output signal (0.2 amp @ 24V dc/ac) to indicate Actuator operation. These may be employed to trigger other displays or alarms.

6. Testing

(a) Mounted externally on the control panel shall be a Test switch to provide a full cycle test of each individual actuator. During the test cycle, the microprocessor shall self-test as well as check cable-motor continuity and the battery under load conditions. Test procedures as outlined on the Actuator and control panel labels shall provide the operator with “Go” - ”No-Go” criteria. Test results are confirmed by operator observation and the tactile force required in re-opening the valve.

G. Power Requirements

1. The power supply to operate the control panel shall be (115V ac, 60 Hz) single phase. Current consumption shall be 0.5 amp at 120V ac.

H. Accessories

1. Standard accessories for each Actuator system shall include (1) Stowage bracket for temporary placement of the Actuator during cylinder changes. (2) A twisted type chlorine cylinder wrench.

I. Manufacturer

1. Halogen Gemini Controller System

2. Robo-Control Model U150-21111

2.8 OTHER EQUIPMENT FURNISHED SHALL BE AS FOLLOWS:

A. One (1) standard spare parts kit for each gas system.

B. One (1) leak detection kit for each system.

C. One (1) Emergency Kit A and sulfur dioxide gasket kit.

D. One (1) self-contained compressed air breathing unit, sling-pack style, minimum 30-minute service period capacity rating, furnished transport, and storage case. The unit shall be manufactured by MSA or equal and shall be NI0SH certified.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All items shall be installed in accordance with the manufacturer’s recommendations, instructions, and directions. Equipment shall be installed as indicated on the schematic drawings. Sulfonation and chlorination equipment and scale shall be installed for convenient operator viewing through window in chemical feed room.

B. All openings in walls, floors, or ceilings in the gas storage or gas feed rooms made for installation of field piping shall be sealed air-tight.

C. All gas and liquid piping systems shall be carefully installed to ensure non-leakage.

D. A flashing red light for the gas detection system shall be installed on the exterior of the monitored area.

E. Contractor shall notify Engineer and Manufacturer when the equipment is ready for start-up.

**** END OF SECTION ****

SECTION 46 33 08 – SUPPLEMENTAL CARBON FEED SYSTEM

PART 1 -- GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall furnish and install a complete supplemental carbon feed system consisting of pumping equipment for metering and feeding, and related accessories. The metering pumps shall be flow-paced by the appropriate flow signal in accordance with Section 40 90 00.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 90 01 - Measuring and Control Instruments

B. Section 26 90 02 - System Control

C. Section 40 23 00 - Pipe and Pipe Fittings

D. Section 46 30 00 - Chemical Feed System, General

1.3 SUBMITTALS

A. As specified in Section 01 33 00 – Submittals.

1.4 STARTUP AND TRAINING

A. Equipment manufacturer/supplier shall provide startup and instruction as specified in Section 46 30 00, Paragraph 1.5.

PART 2 -- PRODUCTS

2.1 MANUFACTURER OR EQUAL

A. Watson Marlow-Bredell (Qdos)

B. Blue White (FlexFlo)

2.2 SCHEDULE OF EQUIPMENT

A. Metering Pumps

B. Accessories

2.3 METERING PUMPS

A. Pumps shall be peristaltic hose type complete with appurtenances as indicated and specified.

B. Pump manufacturer must provide pumps and accessories integral to pump operation and specified herein as a coordinated package, regardless of manufacturer. This includes pumps, gear reducers, motors, pulsation dampeners, leak detectors, control panels/drives, and other accessories specified under this section. Equipment specified herein that is not supplied by the pump manufacturer as an integrated package will be rejected.

C. The manufacturer of the hose pumps must have at least five operating installations in the United States in the size specified and in the same service as specified for a period of at least 3 years.

D. Hose shall be of the three-layer elastomer with a minimum static burst pressure of 1,090 psi and 53-68 Shore 'A' durometer. The hose shall have an extruded inner layer, two layers of nylon reinforcement, and a Natural Rubber outer layer. Hose OD shall be machined to ± 0.4 mm tolerance. The hose must meet these minimum requirements. The wetted layer shall be EPDM, Natural Rubber, or Buna-N, as required for the service.

E. Rotors shall be Cast Iron ASTM A48 Class 40 with two integrally cast shoes located 180E apart. Pumps using rollers are not acceptable.

F. Housing shall be Cast Iron ASTM A48 Class 40.

G. Cover/Level Sensor shall be Polycarbonate with mounted float type high lubricant level sensor to detect leakage of pumped product into the pump housing. The sensor shall be an NC contact signal to sound the remote alarm, motor power failure, etc. The manufacturer shall supply switches only.

H. Pump shall have its own bearing frame with permanently grease-lubricated antifriction bearings with an AFBMA L10 life rating of 10,000 hours at max design conditions.

I. Support Frame shall be 304 stainless steel with a 304 Stainless Steel coupling guard. Provide motor and drive bolted to the common baseplate. Provide holes in the base for anchor bolts.

J. Motor shall be permanent magnet DC motor, 1 HP max 120/1/60 TEFC, NEMA C frame. Provide NEMA 4 enclosed SCR Drive with local start/stop/speed control and local/remote switch - 4-20 mA speed control when in 'remote'. The pump shall be capable of 20:1 turndown from max speed.

K. Provide two (2) hoses per pump and two (2) hose lubricant refills per pump.

L. Pump shall have an operating range as follows:

	P-C-1, P-C-2
Minimum Flow Rate (gph)	0.01
Maximum Flow Rate (gph)	20
Minimum Discharge Pressure (psi)	100

2.4 ACCESSORIES

A. The feed system shall be furnished with the following accessories:

1. Suction, discharge tubing, and necessary valving.

2. Preassembled stand or shelf for installation near chemical storage drums and suitable for suction lift from active drum(s).

2.5 CHEMICAL STORAGE

A. Two (2) low-profile, polyethylene drum spill decks with an 8-foot-wide ramp for the storage of up to eight 55-gallon drums, as indicated.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall install all equipment specified herein in accordance with the manufacturer's instructions and as shown on the plans to provide a complete operating system.

B. The CONTRACTOR shall furnish and install piping from the chemical feed room to the point of application.

C. Shelving or stands for pumps and level measurement for active drum on the wall with toggle bolts, and manufactured of polyethylene or other acid-resistant material.

3.2 PAINTING

A. Equipment and piping shall receive coatings as specified in Section 09 91 00 “Wastewater Treatment Facility Painting”.

**** END OF SECTION ****

SECTION 46 41 21 – JET MIXING/AERATION SYSTEM

PART 1 -- GENERAL

1.1 SUMMARY

A. The equipment furnished under this section shall be a submerged jet aeration system. The system shall be designed to uniformly oxygenate the mixed liquor and maintain the suspension of biological solids. The system shall consist of jet aeration headers with a flush-out system, motive liquid pumps, aeration blowers, and all in-basin liquid piping, air piping, and supports.

1.2 RELATED SECTIONS

A. Section 01 33 00 - Submittals

B. Section 26 24 19 - Starters and Motor Controls

C. Section 26 24 20 - Motors

D. Section 43 00 00 - Equipment General Provisions

E. Section 43 25 00 - Submersible Centrifugal Pumps

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 - Submittals.

B. Shop drawings shall include the following data in addition to the information specified in Section 01 33 00 – Submittals.

1. Equipment name, identification number, and specification number.

2. Performance curves for pumps and blowers (if applicable).

3. Detailed equipment description and specification.

4. Electrical data, including control and wiring diagrams.

5. Assembly and installation drawings, including material list, dimensions, and shipping weights.

C. O & M Manuals shall be specific to the equipment furnished and include all required catalog cut sheets, drawings, instructions, and other materials required to instruct operating and maintenance personnel in the proper use, adjustment, operation, and repair of equipment furnished.

1.4 QUALITY ASSURANCE

A. The jet system manufacturer shall include with its bid a Certification of Compliance, stating that the aeration system provided fully complies with the materials of construction stated herein, including all ASTM and National Bureau of Standards specifications listed in this section.

B. The aeration system shall be installed as shown on the plans. The system shall be designed to provide complete mixing without the use of the aeration system.

1.5 WARRANTY

A. The manufacturer shall warrant the equipment provided against defects in workmanship and materials for a period of five (5) years under normal use, operation, and service. A copy of this

warranty shall be placed on file with the Owner and Engineer prior to the installation of the equipment.

B. Warranty period shall begin following certification of installation and start-up by manufacturers' representative.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS OR EQUAL

A. Jet Tech Products

B. Fluidyne

2.2 PERFORMANCE REQUIREMENTS

A. Anoxic Basins: Complete Mix w/out Aeration

1. Number of Basins – 4
2. Basin Dimensions (each):
   Length = 37.17-ft
   Width = 14.5-ft
   Depth = 15.7-ft
   Volume = 0.06 MG
3. Number of Motive Pumps = 4
4. Motive Pump Capacity (minimum) = 810 gpm

B. Aeration Basins 1B/2B: Complete Mix w/out Aeration

1. Number of Basins – 2
2. Basin Dimensions (each):
   Length = 68.75-ft
   Width = 37.17-ft
   Depth = 16.25-ft
   Volume = 0.30 MG
3. Number of Motive Pumps = 2
4. Motive Pump Capacity (minimum) = 2,000 gpm

2.3 JET MIXING/AERATION HEADERS

A. Four (4) aeration headers shall be provided for the Anoxic Basins, and two (2) jet mixing headers shall be provided for the Aeration Basins. Each jet aeration header shall be comprised of a liquid duct, an air duct (if applicable), and jet aerator assemblies. Each header shall be constructed such that the liquid duct, air duct, and jet aerator assemblies comprise one self-contained unit and shall be shipped as such, complete and ready for installation. Headers in excess of forty (40) feet in length may be shipped in sections. A maximum of one "field joint" may be required for each forty (40) feet of header length.

B. The liquid duct shall be a cylindrical member having a plurality of liquid nozzle entry orifices, which are longitudinally spaced along its perimeter and aligned on a common horizontal plane. The inner surface of the liquid duct shall be smooth and free of protrusions that might collect stringy material.

C. The air duct shall also be a cylindrical member parallel to and above the liquid duct. The air duct shall be joined to and supported by the air manifolds and additional support points as necessary. The air duct shall have a plurality of air manifold entry orifices longitudinally spaced along its perimeter, in the corresponding number to, and in vertical alignment with, the liquid nozzle entry orifices of the liquid duct. The provision of a separate air entry manifold with a fixed orifice for each jet assembly shall ensure uniform air distribution.

D. The liquid and air ducts shall be machine filament wound fiberglass reinforced thermosetting resin pipe. Liquid and air ducts shall be fabricated in strict accordance with ASTM Specification D-2996-01. Hand filament wound FRP piping (fabricated in accordance with NBS specifications), PVC, or other thermoplastics are not acceptable. Minimum acceptable pipe wall thickness (including corrosion liner) shall be per the following table:

Diameter	Wall Thickness
4”	0.104
6”	0.146
8”	0.146
10”	0.188
12”	0.188
14”	0.230
16”	0.272
18”	0.272
20”	0.314
24”	0.356
30”	0.440

E. The minimum pressure rating of the aeration header shall be 75 PSI. The minimum pressure rating is an internal rating. It must have a minimum 5:1 safety factor against short-term burst hoop tensile strength and a 1.8:1 safety factor against long-term hydrostatic design basis. For systems utilizing flush-out, the header shall be designed for an appropriate external PSI vacuum rating for the service conditions and have a minimum of 3:1 safety factor against hoop tensile strength. The manufacturer shall be able to provide calculations and structural wall thickness in regard to the intended service conditions.

F. Each jet aerator assembly shall consist of an inner liquid nozzle and an outer air/liquid delivery nozzle. The inner and outer nozzles shall be aligned on a common centerline, joined together, and laminated to form a single unit. The jet aerator assembly shall be joined to the liquid duct and the air manifold and laminated for strength to form a single integrated unit. Systems with non-integral jets will not be accepted. The matting surface of the jet aerator assembly shall match the contour of the liquid duct and be stepped to match the liquid nozzle entry orifices of the liquid duct to ensure proper alignment and provide a smooth contoured liquid flow patch. No portion of the liquid nozzle or aerator assembly shall protrude into the liquid duct.

G. In order to reduce plugging potential, the liquid nozzles shall constantly be reducing the cross-sectional area in the direction of flow. There shall be no parallel section in the liquid flow path between the liquid duct and the exit orifice of the liquid nozzle. The distance between the exit orifice of the inner nozzle and the exit orifice of the outer nozzle shall be such that substantial air entrapment by the liquid stream occurs prior to its discharge from the outer nozzle.

H. The outer exit orifice shall have a cross-sectional area of at least 2.5 times that of the inner nozzle exit orifice. The outer nozzle shall constantly be reducing the cross-sectional area in the direction of flow

with an included angle of at least 20° for at least nine inches along the flow path to increase the velocity of the air/liquid stream.

I. Both inner and outer nozzles shall be of a non-clog design, free from all protrusions which might collect stringy material, and be capable of passing 2-1/8" spherical solids. Inner and outer nozzles shall be fabricated of isophthalic, corrosion-resistant laminating resin, reinforced with glass fibers, and a surfacing material of a commercial-grade chemical-resistant glass having a coupling agent. The interior of each air and liquid nozzle shall contain a "no abrasion" liner to specifically achieve optimum chemical and abrasion resistance. Each nozzle shall contain a specific liner separate from the structural fiberglass wall of the nozzle. The liner shall be constructed of a glass laminate utilizing a minimum of 2 layers of 0.010-inch synthetic, apertured "Nexus" or "C-glass" veil. The interior liner shall be a resin-rich surface layer containing no more than 20% by weight of either synthetic or "C-glass" veil and shall be free from cracks and crazing. The exterior of the outer nozzles shall be protected with a separately cured, pigmented paraffin gel coat to protect from UV degradation. All construction shall be in accordance with the American Voluntary Standard PS 15-69 or the Canadian Voluntary Standard 41 GP-92.

J. The air manifolds shall be enclosed conduits that convey the compressed air from the air duct to the jet aerator assembly. The air manifolds shall be fabricated of an isophthalic, corrosion-resistant laminating resin, reinforced with glass fibers, and a surfacing material of a commercial-grade chemical-resistant glass having a coupling agent. Air manifolds shall be fabricated in accordance with NBS Specification PS 15-69.

2.4 AIR PIPING

A. All in-basin air piping shall be provided as a part of the aeration system. The piping shall be of adequate length and diameter to transport the air from a point at the top of the basin wall, as shown on the plans, to the air duct of the aeration header. The hardware required to complete this flanged interface connection will be supplied by the contractor. In-basin air piping shall be machine filament wound, fiberglass-reinforced thermosetting resin pipe fabricated in strict accordance with ASTM Specification D-2996-01.

B. Air piping not required for jet headers provided for Aeration Basins 1B and 2B.

2.5 LIQUID PIPING

A. All in-basin liquid piping shall be provided as a part of the aeration system. The piping shall be of adequate length and diameter to transport the motive liquid from the pump discharge connection, as shown on the plans, to the aeration header. A flanged connection shall be provided at this interface point, and hardware to complete this flanged connection shall be supplied by the manufacturer. In-basin liquid piping shall be machine filament wound, fiberglass-reinforced thermosetting resin pipe fabricated in strict accordance with ASTM Specification D-2996-01.

2.6 SUPPORTS

A. All necessary supports for the aeration headers, in-basin liquid piping, and flush-out system shall be provided as a part of the aeration system. Header supports shall be of the single-leg design with a minimum of three ½" anchor bolts. The supports shall be fabricated of commercial quality carbon steel, sandblasted to a near-white finish, and coated with an Epoxy-Polyamide coat of 7-11 mils dry film thickness for corrosion resistance.

B. The supports shall consist of a contoured saddle and a supporting base. The base shall be anchored with anchor bolts and grouted in place, if necessary. The saddle shall be provided with a Buna-N rubber pad to avoid abrasion. A contoured clamp with an accompanying Buna-N rubber pad shall hold the piping to the saddle. Fastening hardware shall be Type 18-8 stainless steel.

2.7 MOTIVE LIQUID PUMPS

A. Submersible mixing pumps shall be provided as specified in Section 43 25 00 Submersible Centrifugal Pumps.

2.8 AERATION BLOWERS

A. Aeration blowers are not required. Existing blowers may be utilized with the Anoxic headers, as needed.

2.9 ANCHOR BOLTS

A. Anchor bolts of sufficient size and quantity shall be provided for mounting all manufacturer-supplied SBR equipment and piping in the basin. The anchor bolts shall be a two-part stud and acrylic resin system. The anchor system shall consist of acrylic resin and hardener contained in a dual cartridge with a static dispensing nozzle. Each anchor bolt shall be supplied with a stud, flat washer, lock washer, and nut of Type 18-8 stainless steel.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as shown unless otherwise approved by the Engineer.

3.2 ALIGNMENT

A. Equipment shall be field-tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

3.3 LUBRICANTS

A. The installation work shall include furnishing the necessary oil and grease for initial operation.

3.4 FIELD SERVICE

A. The system manufacturer shall provide an installation dry check consisting of one trip of two (2) man-days and start-up, operator instruction, and training service consisting of one trip for a minimum of two (2) man-days. All service shall be carried out by a qualified service technician. Written service reports of each service phase shall be distributed to the Engineer and Owner.

**** END OF SECTION ****

SECTION 46 43 21 - CLARIFIER EQUIPMENT - SUCTION TYPE CLARIFIER

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install sludge collection (suction type) and surface skimming clarifier equipment to fit circular final clarifier basins shown on the plans.

B. The bid price shall include the cost of any structural or piping modifications necessary for equipment installation.

C. Each sludge collector and surface skimmer unit shall be of half-bridge support with influent feed through the center and overflow into peripheral launders, as shown in the plans.

D. All electrical equipment shall be explosion-proof, and the micro switches shall be spark-proof.

E. Except where indicated otherwise, all plates and structural members designated for submerged service shall have a minimum thickness of 1/4 inch. All fasteners shall be 304 stainless steel. All anchor bolts shall be 304 stainless steel.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittals

B. Section 06 80 00 – Fiberglass Baffles and Weir Plates

C. Section 26 40 20 – Motors

D. Section 26 90 01 – Instrumentation

E. Section 26 90 02 – System Control

F. Section 43 00 00 – Equipment General Provisions

1.3 EQUIPMENT DETAILS

A. Each clarifier mechanism shall include the following major components:

1. Sludge collector drive complete with reducer, motor overload device, and rotating drive cage.
2. Center pier and center cage.
3. Unitube sludge removal header, supports, manifold, and truss scraper arms.
4. Influent well.
5. Walkway including handrailing and toe plate.
6. Surface skimmer with scum trough and skimmer blade ramp.
7. Scum baffles and effluent weir.
8. Local control panel.
9. Anchor bolts and other fastening hardware.

1.4 GENERAL DESCRIPTION

A. The clarifier equipment shall be a half-bridge type, pier supported with siphon feed and peripheral overflow.

B. The sludge collector drive mechanism shall support and rotate a center cage to which are attached the manifold and header supports.

C. The header shall have a series of inlet orifices designed for uniform sludge withdrawal so that in a single revolution, the entire tank bottom is swept clean.

D. The sludge shall be transported through the header to the center outlet, with removal being accomplished by gravity flow.

E. The mechanism shall be designed so there shall be no field welding required.

1.5 DESIGN CRITERIA

A. The hydraulics shall be designed to handle per basin:

	Min.	**Ave.**	**Max.**
Effluent Flow (mgd)	0.28	0.47	0.99
Return Flow (mgd)	0.47	0.47	1.40
Mixed Liquor Flow (mgd)	0.75	0.94	2.39
Inside Diameter (ft.)	45’-0”		
Side Water Depth (ft.)	14’-0”		
Bridge Deck to Water Depth (ft.)	5’-5”		
Floor Slope	1/16” in 12” (±)		
Influent Well Size	8’-7” dia. x 5’-0” depth		
Center Pier Diameter (in.)			
Maximum Suction Header Velocity (ft/sec)	3.5	0.5	1
Minimum Suction Header Velocity (ft/sec)	1.0		
Maximum Suction Header Headloss (ft)	2.0	2.0	2.0
Minimum Orifice Diameter (inch)	1.9		
Rake Mechanism Rotation Speed (rpm)	0.04		

1.6 REFERENCE CODES, SPECIFICATIONS, AND STANDARDS

A. Commercial Standards

ASTM A36	Specifications for Structural Steel.
ASTM A48	Specification for Gray Cast Iron.
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Casting on Iron and Steel
ASTM A276	Specification for Stainless Steel Bars and Shapes
ASTM A325M	Specification for High Strength Bolts.
AGMA 6034-A87	American National Standard for Enclosed Cylindrical Worm Gear Speed Reducers and Gear Motors.
AGMA 2001-B88	American National Standard Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
AWS D1.1	American Welding Society. Structural Welding Code Steel.

1.7 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Shop Drawings shall be in accordance with Section 01 33 00 “Submittals”.

B. Equipment supplier shall furnish six copies of the following with the shop drawing submittals:

1. Dimensional Drawings and Mechanical Details.
2. Torque calculations for drive unit components.
3. Structural calculations of the bridge, rake arm, and cage design.
4. Weight of each major component.
5. Wiring diagrams.
6. Installation manual and instructions.

C. **O & M Manuals:** The equipment supplier shall furnish four copies of OWNER and operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. The manufacturer shall modify his standard equipment to meet the design and intent of this specification.

B. The equipment manufacturer shall submit a list of not less than fifteen (15) operating installations as evidence of experience in the application, design, and manufacture of this type of sludge collector mechanism.

C. Within 30 days after bid opening, the Contractor shall provide performance verification data that the proposed header design does remove the proportional settled sludge volume to ensure hydraulic balance in the tank and uniform sludge withdrawal for the entire tank bottom.

D. This verification shall have been on an existing final clarifier under the following field conditions:

1. Actual plant operation.
2. Diameter of the basin is equal to or greater than the equipment specified.
3. Withdrawal sludge concentrations varying from 5,000 mg/l to 20,000 mg/l.
4. Withdrawal sludge flow of at least 700 gpm (1.0 MGD).
5. Velocity in the header at maximum flow to be in the 3.0 to 4.5 fps range.
6. Head loss at maximum flow to be under 2’ for the header.

E. Service

1. The Contractor shall include with his bid the services of the equipment manufacturer’s field service technician for a minimum period of (12 hours) with at least two visits to the job site.
2. This service shall be for the purpose of checkout, initial start-up, certification, and instruction of plant personnel.
3. A written report covering the technician’s findings and installation approval shall be submitted to the Engineer who is covering all inspections and outlining in detail any deficiencies noted.

1.9 WARRANTY

A. The equipment shall be warranted by the equipment manufacturer to be free of defects in materials and workmanship for a period of two (2) years from the date of the startup. The cost of labor, materials, and shipping for repairs required during this period shall be paid by the manufacturer.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS OR EQUAL

A. Suggested Manufacturers

1. Evoqua/Envirex
2. Walker Process
3. WesTech
4. Ovivo/Eimco

B. The naming of a manufacturer in this specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified. Any exceptions to the specifications shall be duly noted in the submittals.

2.2 GENERAL

A. All ferrous metal parts of the clarifier mechanism shall be 304 stainless steel, in accordance with ASTM A276. Field repairs shall be as specified in Section 05 50 00. No painting is required on stainless steel equipment.

2.3 STRUCTURAL MEMBERS

A. All structural steel shall conform to ASTM A276. All steel parts shall have a minimum thickness of 1/4-inch.

B. All connections shall be shop welded, or field bolted. No field welding will be permitted.

C. All welding shall conform to AWS D1.1.

D. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations and properly match-marked for ease of field erection.

2.4 SLUDGE COLLECTOR DRIVE MECHANISM

A. Drive Details: The values indicated for the following parameters shall be considered as the minimum acceptable values.

1. Spur gear pitch dia. 26-inches.
2. Ball race dia. 30-inches.
3. Motor horsepower 1/2 hp, explosion-proof.
4. AGMA rated torque (24-hours continuous duty and 20-year life) 12,100 ft.-lbs.
5. Speed 0.04 rpm.
6. Alarm Torque @ 12,000 ft.-lbs., shut-off @ 14,520 ft.-lbs., shear pin @ 15,730 ft.-lbs.

B. Drive Mechanism Details

1. The drive mechanism shall be completely factory assembled and shall consist of a primary reduction, intermediate reduction, and final reduction unit in accordance with AGMA Section 6034-A87, and AGMA 2001-B88, for 24-hour continuous duty and 20-year life, based on AGMA rated torque.
2. All gearing shall be enclosed in gray cast iron ASTM A-48, Class 40B, or A36 steel housings. Exposed gearing will not be acceptable.
3. The primary reduction unit shall be a helical gear, heavy-duty gear reducer. All bearings shall be anti-friction type and running in oil or grease in a cast iron or steel housing.
4. The primary reduction unit shall drive the intermediate reduction unit through a chain and sprocket arrangement or direct connected. The drive chain shall be 80L self-lubricated roller chain and be covered with an OSHA approved removable guard of molded polyethylene or galvanized steel. Proper chain tension shall be provided by an adjustable steel base mounted on the intermediate reduction unit.
5. The intermediate reduction unit shall be a heavy-duty, worm gear speed reducer in a gray cast iron housing with grease and oil-lubricated anti-friction type bearings. The unit shall be mounted on a machined face on the top of the final reduction unit and properly aligned to maintain accurate centers for the final reduction gearing.
6. The final reduction worm gear shall be a cut-tooth casting mounted on an anti-friction ball bearing assembly.
7. The balls shall be high carbon alloy steel running on replaceable hardened alloy steel races.
8. The final reduction gear and the anti-friction ball bearings shall run in an oil bath within the final gear reduction housing or be grease lubricated. The housing shall be effectively sealed against contaminants.
9. A readily accessible oil filling and level pipe with a sight gauge shall be furnished.
10. The motor shall be explosion-proof, ball bearing, of ample power for starting and continuously operating the mechanism without overloading. The motor shall conform to the requirements of Section 26 24 20 of these Specifications.
11. The overload device shall be mounted on the drive head at the thrust end of the worm shaft and consist of: a plate spring assembly, a plunger, an indicator dial, two (2) micro switches (both N.O.), and a terminal block, all enclosed in a weather-tight, gray iron Class 40B or stainless steel housing, gasketed and mounted to the gear housing. The end thrust of the worm shaft against the plate spring shall actuate the plunger, which in turn shall move the indicator dial. The microswitches shall be spark-proof NEMA 7.
12. A visual torque dial indicator shall be provided and oriented so it may be read from the walkway.
13. The microswitches shall be factory set to 1) sound an alarm when the load on the mechanism reaches 100% of the AGMA rated torque capacity of the drive and 2) stop the motor when the load reaches 120% of the AGMA rated torque capacity. A shear pin device set for 130% of the AGMA-rated torque.
14. The internal final gear shall be driven by a heat-treated steel pinion from the slow-speed shaft of the intermediate gear reduction unit. The internal gear shall be split for easy removal, shall be of ductile iron or forged steel, and shall be designed to support the center cage and collector.
15. The turntable base shall have an annular raceway to contain balls upon which the internal gear rotates. The ball race shall ensure a low unit ball load, long life, and stability without the

necessity of guide shoes or steady bearings. The balls shall be alloy steel and shall bear vertically and horizontally on four (4) renewable special hardened (38-42 Rockwell C) steel liner strips force-fitted (pins or cap screws not permitted) into the turntable base and internal gear. The internal gear, pinion, and ball race shall run in an oil bath and be protected by a felt seal and steel dust shield.

16. The turntable base shall be bolted to the center column and be designed to support the internal gear with the rotating mechanism and the access bridge. An oil filling and level pipe, along with a drain plug and sight gauge, shall be furnished as part of this unit. A pipe shall be attached to the bottom of the turntable base for purposes of condensate removal. The oil piping shall terminate within the center of the base for easy access.

17. The turntable assembly shall be so designed that the split internal gear, balls, and strip liners may be removed without raising the access bridge, or the bearing balls shall be replaceable without unbolting the drive cage or disassembly of the drive.

18. The drive mechanism shall be designed in accordance with AGMA 2001-B88 and 6034-A87, for 24-hour continuous duty and 20-year design gear life, based on the AGMA-rated torque. Bearings shall be designed for a B10 life of 200,000 hours.

2.5 CENTER PIER AND INFLUENT WELL

A. The influent shall be fed through the center stainless steel pipe. The center pier shall be fabricated of not less than 1/4” stainless steel plate reinforced where necessary. The center pier shall be anchored to the concrete base with hooked anchor bolts.

B. Each center pier shall be fabricated with large ports with the upper end to direct flow into the center well at a velocity not to exceed 1 ft/sec.

C. Each final clarifier shall be equipped with an influent baffle circular well of the size specified. The baffle shall provide efficient hydraulic control of flow entering the clarifier and shall be provided with scum ports. The ports shall be baffled to prevent short-circuiting to the effluent weir.

2.6 CENTER CAGE

A. A center cage shall be bolted to the final reduction gear of the sludge collector drive and shall support the manifold, the scraper arm, the influent well, the header, and supports.

B. The center cage shall be of all-welded construction, made up of structural stainless steel members having a minimum thickness of 1/4 inch.

2.7 HEADER

A. The header, of a rectangular-shaped full tapered section, shall vary in size from a maximum near the tank center to a minimum at the outer end to provide uniform sludge draw-off velocities throughout and shall be fabricated of 1/4” thick steel plate, galvanized after fabrication. The header shall provide a minimum flow velocity throughout of 0.5 fps with a maximum head loss of 0.5 ft. The header shall discharge into a center sludge manifold. The manifold shall be conical or cylindrical shaped to prevent solids settling and shall be fabricated carbon steel 1/4” minimum thickness.

B. The longitudinal cross-sectional axis of the header shall be mounted at an angle of 45 degrees with the tank bottom to provide a peaked top. The leading edge of the header shall extend downward 2” to provide a fluidizing vane as an integral part of the header and to direct the sludge into the area of influence of the orifices. At the inner end of the header, a flange shall be provided for bolting to the center outlet manifold.

C. The header shall have a scraper of 1/4” stainless steel plate with a neoprene blade to clean the tank bottom around the manifold, directing the sludge to the first orifice.

D. At regular intervals, not to exceed 30”, inlet orifices varying in size from a minimum diameter near the tank center to a maximum at the outer end shall be accurately located in the header. The minimum orifice diameter shall be as specified.

E. The design of each orifice shall be proportionate to the volume of sludge withdrawn, and the design of the orifices and header shall be such as to ensure hydraulic balance in the tank uniform sludge withdrawal from the entire tank bottom at all flows. Refer to quality assurances for details.

F. Sludge withdrawal by means of individual riser pipes or stepped-type construction shall not be acceptable.

G. Control of sludge withdrawal shall be external to the basin and consist of a single operation for each basin. Sludge draw-off will be by gravity.

2.8 MANIFOLD

A. The manifold shall be furnished with upper and lower sealing assemblies and rotate on a steel bearing embedded in the concrete slab. The manifold shall have a minimum 54” lower diameter.

B. The manifold shall be constructed of 1/4” minimum thickness steel and fitted with two (2) sealing rings. The bottom plate shall be securely anchored to the concrete floor and grouted in place after proper aligning. The equipment manufacturer shall furnish a template to accurately locate the anchor bolts.

2.9 SCRAPING

A. Opposite the Unitube header, a truss sludge scraper arm shall be provided, supported from the center cage and manifold, and used for the skimmer support. The arm shall be equipped with scraper blades set and spaced to scrape settled sludge from the tank bottom to a sludge pocket located near the center of the basin. The blades shall be so spaced that the entire tank bottom is scraped once for each revolution of the mechanism.

B. The cage and scraper arms shall be fabricated from structural angles or sections having a minimum thickness of 1/4-inch and be so designed that no member will be stressed beyond the elastic limit when twice the continuous running torque effort of the drive assembly is applied. Stress analysis calculations for each truss member based on design loadings applied to the mechanism shall be submitted by the equipment manufacturer for approval by the Engineer. The scraper arm shall be furnished with steel flights and adjustable 26-gauge brass squeegees.

2.10 SURFACE SKIMMER

A. Each sludge collector mechanism shall be provided with a device to automatically move surface scum to a fabricated stainless steel scum trough extended from the peripheral launders and located as shown on the plans.

B. A “full surface” skimmer shall be furnished consisting of a stationary anti-rotation scum baffle, rotating scum blade and skimming assembly, and scum trough.

C. The stationary anti-rotation scum baffle shall be designed to trap scum as the rotating scum blade approaches and direct the trapped scum out toward the scum trough. The scum baffle shall consist of a structural stainless steel support angle, a 3/8” thick by 12” wide neoprene baffle, and a stainless steel backing bar.

D. The rotating scum blade shall extend radially from the influent well to the skimming assembly. A pivoting skimmer assembly shall be attached to the outer end of the scum blade to form a pocket for collecting the trapped scum. The skimmer assembly shall consist of: Skimmer support tube; skimmer blade; two (2) pivoted blade support brackets; a hinged guide; and scum baffle wipers. The support tube shall be a minimum 2-1/2" square structural stainless steel tube. The skimmer blade shall extend across the full width of the scum trough and shall consist of a "J" shaped blade fabricated from a minimum 1/4" thick stainless steel plate and 1/4" thick neoprene wiper. Neoprene shall be attached to the "J" blade with a 1/4" clamping bar. The mechanism shall ensure continual contact and proper alignment between the skimmer blade, scum baffles, and beach as the blade travels up the beach and over the scum trough.

E. Skimmer blade support brackets shall consist of structural angles attached to the support tube by pivot pins. A hinged guide bar shall be provided to direct scum from the main scum blade to the skimmer blade. The ends of the skimmer blade shall be provided with neoprene scum baffle wipers. The skimmer assembly shall be provided with a means for locking the assembly up and out of the liquid.

F. Skimmers which rely on support from the scum baffle will not be acceptable.

G. Each scum trough shall be approximately 4'-0" wide and the required length. The trough and beach shall be fabricated from a 1/4-inch stainless steel plate and furnished with a flexible coupling and 6-inch standard 125 lb. flanged connection for the scum discharge pipe.

2.11 ACCESS BRIDGE, WALKWAY, DRIVE PLATFORM

A. An all-welded structural stainless steel beam bridge shall span the tank wall and the center pier.

B. The bridge, consisting of two structural members, shall be braced to ensure rigidity.

C. Walkway shall be 3 feet wide and designed for a live load of 150 pounds per lineal foot with a maximum deflection of 1/360 span length.

D. A center drive access platform shall be provided. The platform shall provide a minimum 2'-6" wide workspace on all four sides of the drive unit.

E. Walkway shall be covered with an aluminum checkered plate. The access platform at the drive unit shall be covered with a 3/8-inch minimum aluminum checker plate. The floor plates shall be furnished with removable sections, where required, for access to mechanical equipment.

F. Handrails shall not be used to stiffen the drive platform. The walkway and drive platform shall meet the maximum deflection requirements without handrails being in place.

2.12 HANDRAILS

A. Handrail system shall be an aluminum, three-rail system with 4-inch toe plates designed in accordance with OSHA standards.

B. Handrails shall be furnished and installed as specified in Section 05 52 00 "Handrails and Railings".

2.13 WEIRS AND BAFFLES

A. Equipment shall be furnished with FRP weirs and scum baffles and all mounting hardware.

B. Effluent weirs shall consist of 9-inch deep x 1/4-inch FRP sections with 2 1/2-inch deep 90° V-notches at 12-inch intervals. The weir sections shall be fastened to the tank wall with FRP washers, stainless

steel anchor bolts, and hex nuts to allow vertical adjustment. All joints between walls and weirs shall be sealed with suitable mastic supplied by the equipment supplier.

C. The scum baffle shall consist of 1/4-inch thick FRP attached to the tank wall by FRP angle brackets, stainless steel anchor bolts, and hex nuts to enable vertical and radial adjustment. The depth of scum baffles shall be as indicated in the plans.

D. Scum baffles and weir plates shall be constructed from fiberglass-reinforced polyester resin, matched-die molded to produce smooth, resin-rich surfaces free of voids, porosity, exposed glass, cracks, or crazes. All edges shall be sealed in the mold.

E. Laminate shall be Type "C" (chemical) glass surfacing mat, 10 to 20 mils thick, with a silane finish and a styrene soluble binder, on both sides. Required thickness shall be achieved using the appropriate number of plies of Type "E" (electrical borosilicate) glass mat with chrome or silane finish and styrene soluble binder. Glass content of laminate shall be 28 +/- 3% by weight. Resin fillers shall be 40 +/- 2% of the resin mixture. The final laminate thickness shall be within +/- 10% of the nominal specified thickness.

F. Scum baffles and weir plates shall be 1/4" nominal thickness, and the color shall be aqua. Scum baffles and weir plates shall be laid up with sufficient internal reinforcement to meet the installation requirements.

G. The fiberglass laminate shall have the following minimum physical properties:

		Test Method
Tensile Strength	14,000 psi	ASTM D638
Flexural Strength	25,000	ASTM D790
Flexural Modulus	1.0×10^{6}	ASTM D790
Impact, Notched, Izod Foot Pound Per Inch	15.0 minimum Average 40	ASTM D256
Barcol Hardness		Barcol Impressor-Model GYZJ-934-1
Water Absorption, % 24-hours Average	0.1	ASTM D570
Coefficient of Thermal Expansion-Inch per Inch per Degrees F	15×10^{-6}	

H. Procedure used in determining the above properties shall be in accordance with the ASTM Standards, Part 27, using the method designated above. Hardness tests shall be made on the resin-rich surfaces of the test samples. Test coupons shall be prepared in accordance with the appropriate ASTM test method. Certification from the fiberglass manufacturer will be acceptable in lieu of testing by the fabricator.

I. Manufacturer shall maintain a continuous quality control program and, upon request, shall furnish to the Engineer certified results of the physical tests listed above.

J. Weir plates and scum baffle plates fabricated from 1/4" thick plate stock with cut edges or notches shall not be acceptable.

K. Field cutting of fiberglass items furnished under this specification shall be allowed to only one closure section. The cut edge shall be sealed with polyester resin and catalyst to form a watertight seal.

PART 3 -- EXECUTION

3.1 GENERAL

A. The unit shall allow the tank to be drained through the header to the level of the orifices.

B. All equipment anchor bolts shall be 304 stainless steel, furnished by the equipment manufacturer, and of ample size and strength for the purpose intended. All anchor bolts shall be set by the General Contractor in accordance with the manufacturer's instructions.

3.2 INSTALLATION

A. Contractor shall receive, store, and install equipment as per the manufacturer's installation instructions.

B. All non-submerged bolts, attachments, and anchors shall be 304 stainless steel.

C. All electrical devices shall be corrosion-resistant and protected from hydrogen sulfide attack.

D. Bottom of the clarifier tank shall be grouted to a uniform surface and in close tolerance with the scraper mechanism.

E. Weirs and scum baffles shall be installed level.

F. All equipment that is **not stainless steel** shall be clearly noted with a reason for the exception and galvanized or coated as per Section 09 91 00 "Painting". The Interior of the center column, if it is not stainless steel or galvanized, shall be coated prior to installation.

G. Contractor shall notify OWNER when equipment is ready for manufacturer's start-up service and shall assist OWNER with start-up and testing, including torque testing.

3.3 ACCEPTANCE TEST

A. Sludge collector mechanisms shall be field-tested after erection and in the presence of the Engineer to confirm and verify the structural and mechanical compliance to the torque requirements specified by loading each collector mechanism with 100% and 120% of AGMA rated torque specified. Also, this field test shall include checking the operation of warning and drive shutdown circuitry.

B. Complete test procedures shall be submitted to the Engineer for approval prior to testing; however, testing shall be accomplished with the machine in operation. Loads shall be applied to the mechanisms' truss arms through cables or other means, anchored to the tank floor or wall. Load shall be applied by means of a hydraulic cylinder or springs or any means which allows the machine to rotate.

C. All labor, materials, and test apparatus necessary for conducting the above tests shall be furnished by the Contractor at no additional cost to the City.

**** END OF SECTION ****

SECTION 46 51 21 - COARSE BUBBLE MIXING SYSTEM

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish and install coarse bubble diffusers of stainless steel construction to replace the existing coarse bubble aeration system in Sludge Tanks No. 1 and No. 2.

B. The diffused air mixing system supplied shall, at minimum, include the following:

1. Coarse bubble diffusers of stainless steel construction.
2. Distribution laterals, fittings, and supports.
3. Drop leg and manifold.
4. Suitably sized orifice inserts.
5. Any auxiliary equipment to install a completely operable system.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 40 05 60 - Valves

C. Section 40 23 00 - Process Piping & Fittings

1.3 REFERENCE STANDARDS

A. COMMERCIAL STANDARDS

ASTM A-312	Specifications for Seamless and Welded Austenitic Stainless Steel Pipes.
ASTM A-296	Specifications for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant for General Applications.

1.4 SUBMITTALS

A. The CONTRACTOR shall submit shop drawings and technical data in accordance with Section 01 33 00 for compliance with the specifications. The information submitted shall include the following:

1. Drawings showing plan views and cross-sections of the equipment as installed in the aerobic digester.
2. Fabrication drawings showing details of distribution laterals, drop legs, and manifolds.
3. Detailed layout of anchor bolt locations.
4. Complete and detailed bill of materials, listing all required quantities and spare.
5. Installation, operation, and maintenance manuals.

1.5 DESIGN PARAMETERS

Number of Tanks	2
Volume (cu. ft.)	40,320
Length (ft.)	48.0
Width (ft.)	48.0

Side Water Depth (ft.)	17.5
Air Requirement (scfm/1000 cf)	20-30
Maximum Air Flow per Diffuser (scfm)	15
Minimum Standard Oxygen Transfer Efficiency	10
Pressure Required at Drop Leg (psig)	7.3

A. The manufacturer shall provide the required number of diffusers and adequately sized air piping to meet the specified oxygen transfer and pressure requirements. If larger diameter drop leg piping than specified or shown in the drawing must be furnished to meet the pressure requirements specified, then such changes shall be done at no extra cost to the OWNER.

1.6 QUALITY ASSURANCES

A. Field Service

1. The aeration system equipment supplier shall provide start-up and check-out service and instruction operations for the plant operators by a qualified service engineer. The service engineer shall provide written certification that the aeration equipment has been properly installed. The on-site plant start-up, check-out, and instruction shall be for a period not less than 8 hours during normal business hours.

1.7 WARRANTY

A. All aeration system components shall carry parts and labor warranty for defective material and workmanship for a period of two (2) years from the date of the start-up.

B. Aeration equipment supplier shall also provide a performance guarantee for oxygen transfer capacity and mixing capability. All testing for conformance to these performance requirements may be conducted by the OWNER within two (2) years of start-up.

C. The mixing capacity performance test shall be a sampling survey of the entire aeration basin length, width, and depth. If the mixed liquor suspended solids concentration at any two points varies by more than ten (10) percent, the system shall be declared out of compliance with these specifications, and the equipment supplier shall furnish and install aeration system improvements to bring the system into conformance with the specification for mixing adequacy.

PART 2 -- PRODUCTS

2.1 MANUFACTURER OR EQUAL

A. Axius Water | EDI

B. SSI Aeration, Inc.

C. Xylem | Sanitaire

2.2 DIFFUSERS

A. The diffuser shall be all stainless steel construction with specially designed air release orifices to provide wide band aeration. Air shall be released uniformly along a minimum air band of 24-inches beyond each side of the air distribution header. The diffusers shall also have a minimum air release perimeter of 48-inches.

B. The diffusers shall be of proven non-clog design with no flexible or moving parts. Each diffuser shall consist of a balancing orifice, an inverted air reservoir, air exit ports, and a deflecting type device.

C. A balancing orifice within the 3/4" NPT male pipe connection provides the proper headloss to ensure uniform distribution into the entire plant aeration system. The orifice shall be sized to introduce additional pressure drop as specified in Paragraph 1.6.

D. The exiting ports shall be located on horizontal planes on two levels to discharge air into the liquid.

E. The deflector-type device shall be located below the diffuser. The deflector shall direct the liquid being aerated along the diffuser's outer walls. The air exiting through the ports shall be sheared into relatively small bubbles and distributed into the liquid. The deflector shall also prevent rags and other material from wrapping around or entering the air diffuser.

F. The body of the diffuser shall be constructed of 304L stainless steel, minimum 20-gauge, with a maximum carbon content of .30%. The body of the diffuser shall be seam welded to the end cap and end port. Spot welding is not acceptable. The end cap shall be cast 304L stainless steel conforming to the requirements of ASTM 296, Grade CF3, and shall have a 3/4" NPT male pipe connection equivalent to schedule 80 pipe. The end cap shall include an integral hex head fitting for tightening the diffuser during installation.

2.3 DROP PIPES

A. Drop pipes shall be Schedule 5, Type 304L stainless steel. Each drop pipe shall include a 125 lb. flange of the required size for connection to the manifold piping system. The top of each drop pipe shall have a 125 lb. loose follower flange for connection to the air supply piping. The drop pipe connection to the manifold shall permit pipe alignment and expansion.

2.4 MANIFOLDS

A. Manifolds shall be fabricated in sections up to 35 feet in length.

B. Connections between sections shall be by a flange.

C. Connections between manifolds and laterals shall be either by flange or expansion type coupling.

D. Each manifold shall have a minimum of 2 supports with a maximum spacing of 16 feet.

2.5 LATERALS

A. Laterals shall be fabricated in sections up to 35 feet in length. The bottom elevation of the lateral shall remain the same throughout the tank.

B. Connections between sections of the laterals shall be either by flange or expansion type coupling.

C. Each lateral shall have a minimum of 2 supports with a maximum spacing of 16 feet.

2.6 MATERIALS AND FABRICATION

A. Drop leg, manifolds and laterals shall be fabricated from 304L stainless steel pipe conforming to ASTM A312 and AISI 304L. Other non-welded parts and pieces such as bolts, washers, supports, follower flanges, and anchor bolts shall be made from 304 stainless steel. The drop legs, manifolds, and laterals shall be minimum Schedule 5.

B. All gaskets shall be 45 to 55 durometer (Shore A) neoprene.

C. All 304L material shall conform to the chemical requirements of ASTM 240 and AISI 304L, except that the maximum carbon content shall be limited to .30%.

D. All welding on this equipment shall be completed in the factory. Field welding shall NOT be permitted. All welding shall be by the shielded arc, inert gas, MIG, or TIG method. Filler wire shall be added to all welds to provide for a cross-section and weld metal equal to or greater than the parent metal. Butt welds shall have full penetration to the interior surface, and gas shielding shall be provided to the interior and exterior of the joint.

E. Interior weld beads shall be smooth and evenly distributed with an interior projection not exceeding 1/16 in. beyond the ID of the air header or fittings.

F. The outside welds shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel.

G. After fabrication, all stainless steel piping shall be pickled and passivated.

H. Header supports shall be fabricated of 304 stainless steel. All nuts, bolts, and washers shall be of 18-8 stainless steel. The header saddle shall be of molded fiberglass reinforced polypropylene and make contact with the header for a minimum of 90% of its circumference.

I. All supports shall include a mechanism to provide for a minimum of 1-1/2 inches vertical adjustment for alignment of the header.

J. The design, fabrication, and installation of the entire aeration system shall be such that the diffuser connected to a header can be leveled to within $\pm$ 1/4-inch of a common horizontal plane.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The aeration equipment shall be installed by the Contractor and per the recommendations and instructions of the equipment supplier.

B. Air distribution piping shall be installed level.

C. Contractor shall notify Engineer and aeration equipment manufacturer when equipment is ready for start-up.

D. Contractor shall ensure that all air piping is free of foreign material prior to connecting the air header to air distribution piping.

E. Contractor shall take necessary precautions to prevent diffuser damage during installation. Diffusers found to be damaged as a result of Contractor actions shall be replaced at the expense of the Contractor.

F. Contractor shall notify Engineer when equipment is ready for start-up and testing. The Contractor shall assist Engineer with start-up testing.

G. During start-up, the Contractor shall fill sludge tanks with clean water to a level just above the diffusers. The blowers shall then be started, and the diffusers and piping inspected by the Contractor for leaks. Leaks shall be repaired by Contractor. If leaks are due to defective OWNER furnished equipment, OWNER shall be notified prior to any repair work by Contractor.

**** END OF SECTION ****

SECTION 46 51 33 - FINE PORE MEMBRANE AERATION EQUIPMENT

PART 1 -- GENERAL

1.1 THE REQUIREMENTS

A. The CONTRACTOR shall furnish a fine pore membrane aeration system for activated sludge aeration and for post aeration.

B. The aeration equipment furnished shall, as a minimum, include the following:

1. Fine pore membranes and diffusers.
2. Distribution laterals with base plates.
3. Supports for distribution laterals.
4. Fittings and gaskets.
5. Drop legs and manifolds.
6. Moisture blow-off equipment.
7. Auxiliary equipment.

C. All grid-type aeration equipment shall provide full floor coverage as defined in this section. The maximum distance from any concrete wall shall be 3 feet, and the tip-to-tip distance between diffusers and the distance between diffusers shall not exceed 4 feet.

D. The number of diffusers provided shall meet all of the following conditions,

1. Actual oxygen requirements
2. Flux rate as specified
3. Floor coverage as specified
4. Distance from the concrete walls and tip-to-tip distance between diffusers

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittals

B. Section 40 05 60 - Valves

C. Section 40 23 00 - Process Pipe and Fittings

1.3 REFERENCE STANDARDS

A. COMMERCIAL STANDARDS

ASTM A-312	Specifications for Seamless and Welded Austenitic Stainless Steel Pipes.
ASTM A-536	Specifications for Ductile Iron Castings.
ASTM D-2467	Specification for Socket-Type PVC Fittings-Schedule 80.
ASTM D-1785	Specification for Poly Vinyl Chloride Plastic Pipe Schedule 80.
ASTM D-2855	Practice for Making Solvent-Cement Joints with PVC Pipe and Fittings.
ASTM D-2000	Classification System for Rubber Products in Automotive Applications.

B. “A Standard for the Measurement of Oxygen Transfer in Clean Water”, American Society of Civil Engineers, 1984.

C. “Recommended Standards for Sewage Works”, Great Lakes - Upper Mississippi River Board of Sanitary Engineers.

1.4 SUBMITTALS

A. The CONTRACTOR shall submit shop drawings and technical data in accordance with Section 01 33 00 for compliance with the specifications. The information submitted shall include the following:

1. Drawings showing plan views and cross-sections of the equipment as installed in each tank.
2. Fabrication drawings showing details of distribution laterals, drop legs, and manifolds.
3. Detailed layout of anchor bolt locations.
4. Complete and detailed bill of materials, listing all required quantities and spare.
5. Installation, operation, and maintenance manuals.

1.5 AERATION SYSTEM DESIGN PARAMETERS

A. The aeration system for the activated sludge system shall be designed for the following conditions: See the following table

	Aeration Basins 1A/2A	**Aeration Basins 1B/2B**	**Post Aeration Basin**
Basin Volume (MG each)	0.20	0.30	0.016
Basin Dimension (each)			
Surface Area (sf)	1,500	2,400	144
Side Water Depth (ft.)	17.0	17.0	15.0
Actual Oxygen Requirements (lbs/d)	2,700	2,700	50-110
Maximum Water Temperature (°C)	25	25	25
Alpha Factor (α)	0.45	0.45	0.85
Beta Factor (β)	0.95	0.95	0.95
Minimum Dissolved Oxygen Conc. (mg/l)	2.0	2.0	7.0
MLSS Conc. (mg/L)	3000	3000	NA
Max. Air Flow at AOR (scfm)	2,400	2,400	200
Max. Air Pressure Available at Drop Pipe (psig)	7.5	7.5	6.7
Minimum Standard Oxygen Transfer Efficiency at Design Air Flow Rate	17.5%	17.5%	15.0%
Max. Diffuser Air Flux (scfm/sq. in.)	0.023	0.023	0.023
Max Air Flow per 9” Diffuser (scfm)	2.5	2.5	2.5

B. The manufacturer shall provide the required number of diffusers and adequately sized air piping to meet the specified oxygen transfer and pressure requirements. If larger diameter drop leg piping than specified or shown in the drawing must be furnished to meet the pressure requirements specified, then such changes shall be done at no extra cost to the OWNER.

1.6 QUALITY ASSURANCES

A. FIELD SERVICE:

1. The aeration system equipment supplier shall provide start-up and check-out service and instruction operations for the plant operators by a qualified service engineer. The service engineer shall provide written certification that the aeration equipment has been properly installed. The on-site plant start-up, check-out, and instruction shall be for a period not less than 8 hours during normal business hours.

1.7 WARRANTY

A. All aeration system components shall carry a warranty for parts and labor for defective material and workmanship for a period of two (2) years from the date of the start-up.

B. Aeration equipment supplier shall also provide a performance guarantee for oxygen transfer capacity and mixing capability. All testing for conformance to these performance requirements may be conducted by the OWNER within one (1) year of start-up.

C. The oxygen transfer capacity performance test shall be a steady-state continuous test involving simultaneous measurement of dissolved oxygen and oxygen uptake rates with influent wastewater flow to the tank. If this test indicates that the system is not capable of delivering the specified AOR, then a clean water test shall be conducted by the OWNER to determine the actual SOR and wastewater characteristics (alpha and beta). If it is determined from these tests that the aeration system is not capable of supplying the specified oxygen transfer rate and that the wastewater characteristics are in conformance with the design parameters specified, then the equipment supplier shall furnish and install aeration system improvements to bring the system into conformance with the specification for oxygen transfer rate.

D. The mixing capacity performance test shall be a sampling survey of the entire aeration basin length, width, and depth. If the mixed liquor suspended solids concentration at any two points varies by more than ten (10) percent, the system shall be declared out of compliance with these specifications, and the equipment supplier shall furnish and install aeration system improvements to bring the system into conformance with the specification for mixing adequacy.

PART 2 -- PRODUCTS

2.1 MANUFACTURER OR EQUAL

A. Axius Water | EDI

B. SSI Aeration, Inc.

C. Xylem | Sanitaire

2.2 DIFFUSERS

A. Diffusers shall be a flexible membrane, fine bubble type. Diffusers shall be totally assembled by the manufacturer. The tubular diffuser shall not exceed 25-inches in overall length. Membrane disc diffusers shall have a nominal diameter of 9-inches.

B. Membrane shall be flexible plastic material that is resistant to domestic strength wastewater. Membrane material shall be designed for at least five (5) years of service when operated at an air flux of 0.023 scfm/square inch of effective membrane area. In computing the air flux for diffusers, the following effective area shall be used:

Diffuser Type	Effective Area for Flux Computation (in^2)
9” Disc	59
Flex Air (XL)	107
Flex Air (1/2 meter Magnum)	131

C. The membrane shall be flexible plastic material that is resistant to attack by animal fat and calcification of hard water. Membranes shall be easily replaceable in the field. Membranes shall be attached with corrosion-resistant hardware.

D. Membranes shall be designed for minimal clogging and fouling by biological slimes and calcification of hard water. Diffusers shall be designed for cleaning by periodically increasing the airflow rate.

E. Diffusers shall be designed with an internal check valve assembly that prevents liquid entry in the event that the airflow is interrupted.

F. The diffuser layout shall ensure adequate coverage over the entire floor of the aeration basin. The effective area of the diffusers times the number of diffusers divided by the floor area of the basin shall equal or exceed five (5) percent. The effective diffuser area per diffuser shall be as listed below:

Diffuser Type	Effective Area for Floor Coverage Calculations (in^2)
9” Disc	59
Flex Air (XL)	61.4
Flex Air (1/2 meter Magnum)	67.3

G. The diffuser arrangement shall provide complete mixing of the basin contents as well as the specified oxygen transfer rates. The mixed liquor suspended solids concentration, at any two points in the aeration basin, shall not vary by more than ten percent. If field tests indicate noncompliance with this mixing specification, the equipment supplier shall furnish and install additional diffusers, aeration air blowers, or other improvements which may be required to attain adequate mixing.

2.3 DISTRIBUTION PIPING AND FITTINGS

A. The aeration equipment supplier shall provide drop pipes and basin floor piping and all supports, hardware, and anchors. Pipe supports shall be fabricated of Type 304 stainless steel for corrosion resistance.

B. Basin floor grid piping shall be Schedule 40 PVC for tubular type diffusers and shall have factory drilled orifice holes, and the diffuser shall connect to the header using a saddle connection. The schedule 80 PVC header pipe shall be factory drilled, and saddles shall be used to allow easy installation of the diffuser units. A saddle connection shall be used for all tubular type diffuser connections. For disc-type membrane diffusers, Schedule 40 PVC manifolds and SDR 33.5 laterals will be acceptable. Threaded end caps shall be supplied at the ends of all laterals. All pipe supports and hardware shall be stainless steel. Floor piping and drop piping shall be furnished with expansion joints.

C. All necessary supports for the aeration manifolds shall be supplied as part of the system. The supports shall be fabricated of type 304 stainless steel and fiberglass reinforced plastic for corrosion resistance. The base shall be anchored on anchor bolts and grouted in place. The support saddle shall be provided with a rubber pad to avoid abrasion. A contoured clamp with an accompanying rubber pad shall hold the piping to the saddle using bolted connections between the clamp and saddle.

D. Anchor bolts of sufficient size shall be furnished by the equipment supplier for mounting the equipment in the basin. The anchor bolts shall be Type 316 stainless steel.

E. All supports shall utilize an expansion type of anchor and must be adjustable to allow for leveling.

F. Drop pipes shall be Schedule 5, Type 304L stainless steel. The minimum number of drop pipes for each basin shall be as indicated in the drawing. Each drop pipe shall include a 150 lb. flange of the required size for connection to the aeration air header piping system. The equipment supplier shall furnish all supports and hangers for the drop pipes. All supports shall be stainless steel construction. Drop pipe assemblies shall be shop fabricated and ready for field installation without field welding. The top of each drop shall have a 125 lb. loose follower flange for connection to the air supply header. The stainless steel drop pipe shall be connected to the PVC manifold pipe in a manner that provides for pipe expansion and alignment.

G. All stainless steel surfaces after fabrication shall be completely immersed, pickled, and passivated.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The aeration equipment shall be installed by the Contractor and per the recommendations and instructions of the equipment supplier.

B. Air distribution piping shall be installed level.

C. Contractor shall notify Engineer and aeration equipment manufacturer when equipment is ready for start-up.

D. Contractor shall ensure that all air piping is free of foreign material prior to connecting the air header to air distribution piping.

E. Contractor shall take necessary precautions to prevent diffuser damage during installation. Diffusers found to be damaged as a result of Contractor actions shall be replaced at the expense of the Contractor.

F. Contractor shall notify Engineer when equipment is ready for start-up and testing. The Contractor shall assist the Engineer with start-up testing.

G. During start-up, the Contractor shall fill aeration basins with clean water to a level just above the diffusers. The blowers shall then be started, and the diffusers and piping inspected by the Contractor for leaks. Leaks shall be repaired by Contractor. If leaks are due to defective OWNER furnished equipment, OWNER shall be notified prior to any repair work by Contractor.

**** END OF SECTION ****

APPENDIX A

GEOTECHNICAL EVALUATION

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Chosen Valley Testing, Inc.

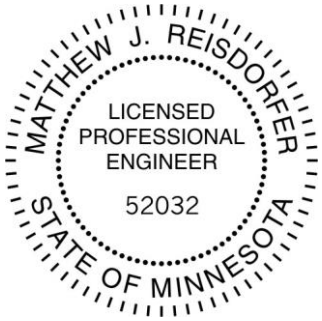
Design Phase Geotechnical Evaluation:

Proposed WWTF Improvements
900 E Farmer Street
Spring Valley, Minnesota
CVT# 23482.24.IAM

Prepared for:

City of Spring Valley
c/o: Bolton & Menk, Inc.
Attn: Mr. Joe Lindquist, EIT

Certification:



I hereby certify that this report 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.

Matthew J. Reisdorfer, PE
Geotechnical Engineer
License Number 52032
Date: July 2, 2024

Chosen Valley Testing, Inc.

Geotechnical Engineering and Testing • 1410 7th St. NW, Rochester, MN 55901 • Telephone (507) 281-0968 • rochester@cvtesting.com

City of Spring Valley
c/o: Bolton & Menk, Inc.
Attn: Mr. Joe Lindquist, EIT
3507 High Point Drive North
Building #1, Suite E130
Oakdale, MN 55128
Joseph.lindquist@bolton-menk.com

July 2, 2024

Re: Design Phase Geotechnical Evaluation
Proposed WWTF Improvements
900 E Farmer Street
Spring Valley, Minnesota
CVT Project Number: 23482.24.MNR

Dear Mr. Lindquist:

We have completed the geotechnical evaluation authorized for the proposed wastewater treatment facility improvements in Spring Valley, Minnesota. This letter briefly summarizes the findings and analysis detailed in the attached geotechnical report.

Summary of Boring Results

Borings: At the surface, the borings met about 2 to 6 ½ feet of clayey fill. Residuum silty sand followed the fill in Boring B-2 to a depth of about 6 ½ feet below the surface.

Weathered limestone followed the fill and sand residuum. Auger refusal, presumably upon slightly weathered bedrock was met in the borings at depths of about 7 to 7 ½ feet below the surface.

Groundwater: Water was not encountered during drilling. Groundwater levels on site would be expected to vary seasonally, similar to water levels in nearby creeks and rivers and with local weather patterns.

Summary of Analysis and Recommendations

The fill is not suitable for support of the structures and should be removed from below building and oversize areas. The fill was met to depths of about 2 to 6 ½ feet below the surface. Based on the finished grading information provided to us, these materials are expected to be removed in order to attain finished grades for the proposed clarifiers and tank.

After excavations are made, subgrade soils are expected to consist of bedrock. These soils are generally suitable for supporting the structure. Auger refusal was met in the two clarifier borings at elevations of about 1260 ½ to 1267 ½ feet, and in the tank boring at about 1276 feet. A large excavator with a toothed

bucket or rock hook should be capable of removing any loose rock fragments that might be encountered. Chiseling will likely be required for the more intact bedrock. Due to the impermeable nature of the bedrock, we recommend a perimeter draintile be considered, to aid in the removal of water.

We recommend geotechnical personnel from Chosen Valley Testing be made available to observe bearing conditions, and to recommend suitability of the exposed soils, or if further corrections are required.

The structures are expected to bear upon bedrock or engineered fill overlying native soils. With the assumed foundation loads and implementation of the earthwork recommendations, we are of the opinion that foundations should be designed using an allowable bearing pressure of 8,000 psf.

Based on these design bearing pressures, total post-construction settlements are expected to be 1 inch or less, and differential settlement is expected to be ½ inch or less between footings that are similarly loaded.

Remarks

For more details of our analysis and recommendations, please see the attached report. We appreciate the opportunity to help you on this project. If you have any questions or need additional information, please contact us at (641) 201-1050.

Sincerely,
Chosen Valley Testing, Inc.

Matt Reisdorfer, PE
General Manager/Geotechnical Engineer

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APPENDIX 10

Design Phase Geotechnical Evaluation
Proposed WWTF Improvements
900 E Farmer Street
Spring Valley, Minnesota

CVT Project Number: 23482.24.MNR
Date: July 2, 2024

A. Introduction

The intent of this report is to present our findings and describe the means used to collect the data. The data was collected for a specific purpose and may not be suitable for other purposes. We should be consulted before attempting to use the data for other uses. A complete and thorough review of the entire document, including its assumptions and its appendices, should be undertaken immediately upon receipt.

A.1. Purpose

This geotechnical report was prepared to aid design and construction of the proposed wastewater treatment facility improvements in Spring Valley, Minnesota. Our services were authorized by Mr. Joe Lindquist, EIT of Bolton & Menk, Inc. on behalf of the City of Spring Valley.

A.2. Scope

To obtain data for analysis, three borings were drilled at the site. The borings were drilled to auger refusal depths of about 7 to 7 ½ feet below the surface. Our engineering scope consisted of providing geotechnical recommendations for the proposed structures.

A.3. Boring Locations

The preferred boring locations were indicated to Chosen Valley Testing (CVT) on a schematic drawing provided by Bolton & Menk, Inc. The Boring Location Sketch in the Appendix shows approximate boring locations as drilled. These locations are based on GPS coordinates from a hand-held GPS unit.

Ground surface elevations were estimated using LiDAR from MnTOPO. These elevations should be considered approximate.

A.4. Geologic Background

A geotechnical report is based on subsurface data collected for the specific structure or problem. Available geologic data from the region can help interpretation of the data and is briefly summarized in this section.

Geologic maps indicate the soils in the area are dominated by alluvial (river deposited) and glacial clays, silts and sands. Bedrock is expected to be within 50 feet from the surface and consists of limestone and dolomite of the Pinicon Ridge, Maquoketa, and Dubuque Formations.

B. Subsurface Data

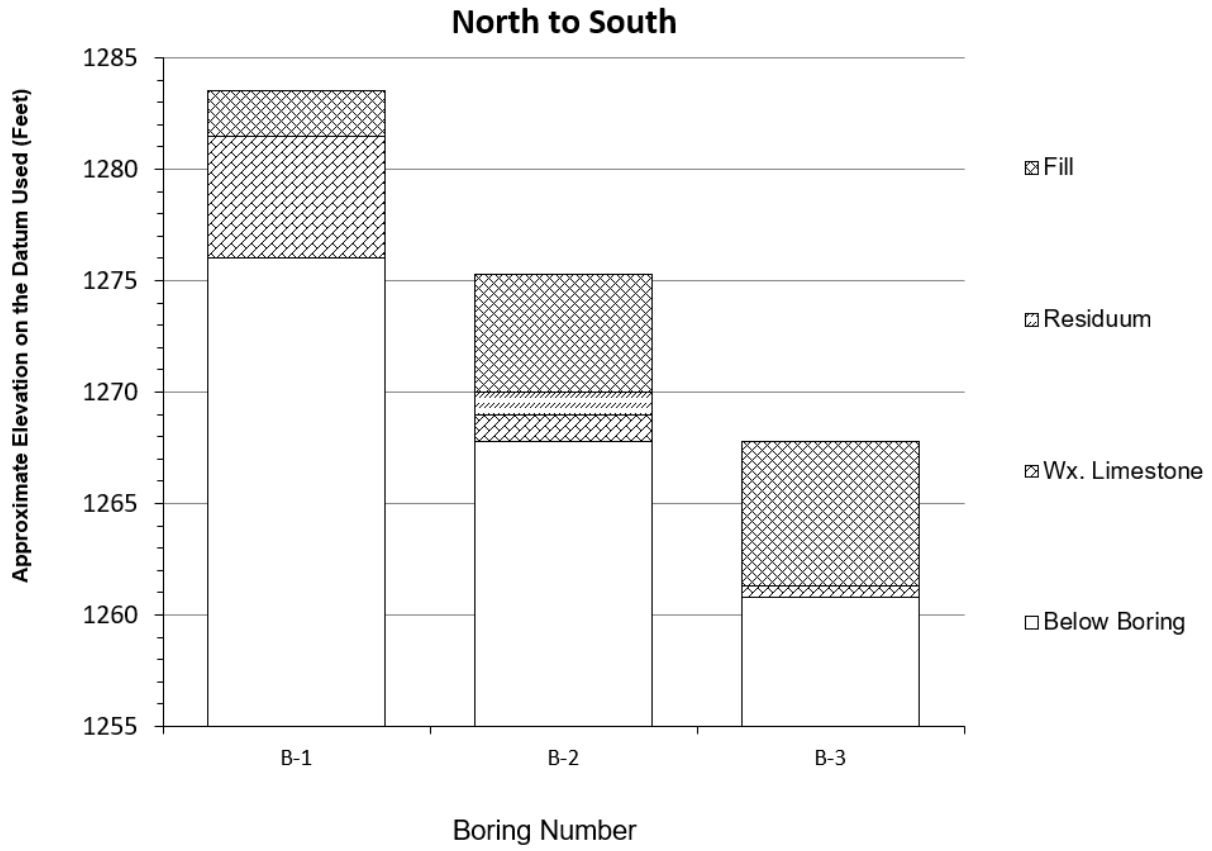
The borings were performed using penetration test procedures (Method of Test D1586 of the American Society for Testing and Materials). This procedure allows for the extraction of intact soil specimen from deep in the ground. With this method, a hollow-stem auger is drilled to the desired sampling depth. A 2-inch OD sampling tube is then screwed onto the end of a sampling rod, inserted through the hole in the auger's tip, and then driven into the soil with a 140-pound hammer dropped repeatedly from a height of 30 inches above the sampling rod. The sampler is driven 18 inches into the soil, unless the material is too hard. The samples are generally taken at 2½ to 5-foot intervals. The core of soil obtained was classified and logged by our drilling personnel at the site and a representative portion was then sealed and delivered to our laboratory for further review.

B.1. Strata

At the surface, the borings met about 2 to 6 ½ feet of clayey fill. Residuum silty sand followed the fill in Boring B-2 to a depth of about 6 ½ feet below the surface.

Weathered limestone followed the fill and sand residuum. Auger refusal, presumably upon slightly weathered bedrock was met in the borings at depths of about 7 to 7 ½ feet below the surface.

For the reader's convenience, the soil boring data has been summarized in the cross-section following this paragraph. For more detailed information, please refer to the Log of Boring sheets in the Appendix.



B.2. Penetration Test Results

Penetration Test Results: The number of blows needed for the hammer to advance the penetration test sampler is an indicator of soil characteristics. The results tend to be more meaningful for natural mineral soils, than for fill soils. In fill soils, density tests are more meaningful.

Penetration resistance values ("N" Values) of 21 Blows per Foot (BPF) to 50 blows for three to six inches of sampler advancement were recorded in the weathered limestone, indicating it was medium dense to very dense. The silty sand residuum returned an N-Value of 24 BPF, indicating it was medium dense. The fill clays returned N-Values of 9 to 16 BPF, indicating they were rather stiff to stiff.

A pocket penetrometer was used to provide additional data on the compressive strength of cohesive soils. The fill clay returned values of 2 ¾ to 3 ¼ tsf (tons per square foot).

A key to the descriptors used to qualify the relative density of soil (such as *soft, stiff, loose,* and *dense*) can be found on the legend to Soil Description in the Appendix.

B.3. Groundwater Data

During drilling, the drillers may note the presence of moisture on the sampler, in the cuttings, or in the borehole itself. These findings are reported on the Logs of Boring. Because water levels vary with weather, time of year, and other factors, the presence or lack of water during exploration is subject to interpretation and is not always conclusive.

Water was not encountered during drilling. Groundwater levels on site would be expected to vary seasonally, similar to water levels in nearby creeks and rivers and with local weather patterns.

C. Design Data

Because each structure has a different loading configuration and intensity, different grades, and different structural or performance tolerances, the results of a geotechnical exploration will mean different things for different facilities. If the design of the facility changes, the soils engineer should be contacted to discuss the possible implications of the changes. Without a chance to review such changes, the recommendations of the soils engineer may no longer be valid or appropriate.

The project involves constructing two clarifiers and a tank. The clarifiers are understood to have a bottom of slab elevation of about 1256 feet and would be constructed with a concrete slab and poured concrete walls. The chemical building is understood to have a bottom of slab elevation of about 1260 feet and will also be constructed with a concrete slab and poured concrete walls.

Loading information and grading information was not available to us at the time of this report. We have assumed minimum bearing capacities of the structures would be 2,000 psf.

D. Analysis

The fill is not suitable for support of the structures and should be removed from below building and oversize areas. The fill was met to depths of about 2 to 6 ½ feet below the surface. Based on the finished grading information provided to us, these materials are expected to be removed in order to attain finished grades for the proposed clarifiers and tank.

After excavations are made, subgrade soils are expected to consist of bedrock. These soils are generally suitable for supporting the structure. Auger refusal was met in the two clarifier borings at elevations of about 1260 ½ to 1267 ½ feet, and in the tank boring at about 1276 feet. A large excavator with a toothed bucket or rock hook should be capable of removing any loose rock fragments that might be encountered. Chiseling will likely be required for the more intact bedrock. Due to the impermeable nature of the bedrock, we recommend a perimeter draintile be considered, to aid in the removal of water.

We recommend geotechnical personnel from Chosen Valley Testing be made available to observe bearing conditions, and to recommend suitability of the exposed soils, or if further corrections are required.

The structures are expected to bear upon bedrock or engineered fill overlying native soils. With the assumed foundation loads and implementation of the earthwork recommendations, we are of the opinion that foundations should be designed using an allowable bearing pressure of 8,000 psf.

Based on these design bearing pressures, total post-construction settlements are expected to be 1 inch or less, and differential settlement is expected to be ½ inch or less between footings that are similarly loaded.

E. Building Recommendations

E.1. General Grading Recommendations

E.1.a. Site Preparation: The fill is not suitable for support of the structures and should be removed from below building and oversize areas. The fill was met to depths of about 2 to 6 ½ feet below the surface. Based on the finished grading information provided to us, these materials are expected to be removed in order to attain finished grades for the proposed clarifiers and tank.

After excavations are made, subgrade soils are expected to consist of bedrock. These soils are generally suitable for supporting the structure. Auger refusal was met in the two clarifier borings at elevations of about 1260 ½ to 1267 ½ feet, and in the tank boring at about 1276 feet.

A large excavator with a toothed bucket or rock hook should be capable of removing any loose rock fragments that might be encountered. Chiseling will likely be required for the more intact bedrock.

Due to the impermeable nature of the bedrock, we recommend a perimeter draintile be considered, to aid in the removal of water.

E.1.b. Geotechnical Review of Excavations: We recommend geotechnical personnel from Chosen Valley Testing be made available to observe bearing conditions, and to recommend suitability of the exposed soils, or if further corrections are required.

E.1.c. Oversizing: Any corrective excavations should be oversized at least 1 foot beyond the foundations for each foot of fill needed below footing grade. This oversizing can be reduced by up to 50% if rather precise staking is present during grading, and the excavation limits can be rather precisely confirmed relative to the foundations.

E.1.d. Filling and Compaction: For ease in compaction, we recommend using sand or gravel having less than 15% particles passing a number 200 sieve, as engineered fill for the project. The on-site clays can should be considered for use in green spaces or under pavements.

We recommend the upper 6 inches of fill placed directly below the slabs consist of clean fill (having less than 5% particles passing the number 200 sieve).

All fill below building and oversizing areas should be compacted to a minimum of 95% of its maximum standard Proctor density (ASTM D 698).

E.2. Building Design

E.2.a. Foundation Design: For frost protection, we recommend that exterior foundations for heated structures bear on soils at least 42 inches below the exposed ground surface. Interior footings for heated structures can be placed directly below slabs. Footings for unheated structures should be placed 60 inches below the surface or should be supported on at least 60 inches of non-frost-susceptible fill.

E.2.b. Bearing Capacity: The structures are expected to bear upon bedrock or engineered fill overlying native soils. With the assumed foundation loads and implementation of the earthwork recommendations, we are of the opinion that foundations should be designed using an allowable bearing pressure of 8,000 psf.

E.2.c. Settlement: Based on these design bearing pressures, total post-construction settlements are expected to be 1 inch or less, and differential settlement is expected to be ½ inch or less between footings that are similarly loaded.

E.2.d. Vapor Barrier and Drainage: If the slab will receive coverings that are less permeable than concrete, a vapor barrier should be placed below the slab. Some contractors prefer to place this barrier below sand, to limit the potential for curling.

Below grade structures should be equipped with drain tiles pumps to aid in removal of any water that accumulates below structures. Water was not encountered in the borings during drilling, although we would expect moisture to leach into and perch above the less permeable bedrock met in the borings.

E.2.e. Slab Design: The completed slab subgrade for all structures are expected to consist of sand or bedrock. We recommend using a modulus of subgrade reaction of no more than 200 pounds per cubic inch for these conditions. We recommend a coefficient of friction between soil and concrete of 0.50 be used.

E.2.f. Below-Grade Walls: Lateral support values are provided for design of below-grade walls. Backfill should be compacted to at least 95% of its maximum standard Proctor density (ASTM D 698). Lateral resistance will depend on the materials used. We recommend using clean sands, having less than 10% fines, as fill against below-grade walls. The actual loads exerted on the structure will depend on the movement or flexure of the structure. For sand fill, horizontal movement or flexure of about 0.2% of the height of soil retained may be sufficient to mobilize frictional forces from the at-rest state to the active state.

The table below includes support values for the recommended clean sands. These values do not include a safety factor.

Poorly Graded Sands (SP) 95% Standard Proctor Density	
Internal Friction Angle (degrees)	34
Cohesion (psf)	0
Coefficient of Friction between Concrete and Soil	0.50
Dry Unit Weight (pcf)	120
Moist Unit Weight (pcf)	120
At-Rest Coefficient (Ko)	0.44
Active Coefficient (Ka)	0.28
Passive Coefficient (Kp)	3.54

E.3. Seismic Design

In accordance with the 2018 International Building Code (IBC), the site profile is considered to rate as Site Classification D.

F. Utilities

F.1. Groundwater/De-watering

Water was not encountered in the borings during drilling and none of the samples returned appeared to be excessively wet. We would expect moisture to leach into and perch upon the less permeable clays and bedrocks. A sump pump and sump pit is expected to be capable of removing any moisture that accumulates within excavations.

F.2. Trench Sidewalls

The contractor performing the work will need to slope or shore the excavations as needed to provide safe conditions. Sands and any saturated clays would likely classify as Type C materials as defined by OSHA. Any clays encountered would likely be classified as Type B material as defined by OSHA. Due to the presence of existing roadways, utilities, and structures, trench boxes or other stabilization methods will likely be necessary.

F.3. Trench Bottom Stability

Utilities are expected to bear on lean clays or bedrock. These soils are expected to be generally suitable for support of utilities. We also recommend that oversize materials be removed from at least 6 to 8 inches below and around pipes, and replaced with sand or gravel bedding (to prevent point loads from developing and rupturing utilities). This type of condition is considered more likely in those areas where the borings encountered in the areas dominated by gravels, cobbles or boulders.

F.4. Fill Placement and Compaction

Soils placed as backfill below paved areas should be compacted to at least 95% of their standard Proctor density (ASTM D 698). In green areas, 90% compaction is normally adequate. Again, cobbles and boulders should be kept at least 6 to 8 inches away from pipes, to limit potential for point loads.

The on-site soils available as fill are expected to consist of clays and some weathered bedrock. These materials are expected to be generally suitable for reuse as backfill above the pipes and for supporting the pavements. To promote uniformity, we suggest using such sandy clay materials in the upper portion of the trench where the near-surface soils outside the trench are dominated by clays, and using granular soils in those areas where granular soils dominate outside the trench.

G. Construction Recommendations

G.1. Excavation

The excavations can likely be performed with a variety of equipment, provided the soils are not overly wet. We recommend using a backhoe for deep excavations.

A large excavator with a toothed bucket or rock hook should be capable of removing any loose rock fragments that might be encountered. Chiseling will likely be required for the more intact bedrock.

G.2. Backslopes

The contractor performing the work will need to slope or shore the excavations as needed to provide safe conditions. The clay soils at the site would likely be classified as Type B material as defined by OSHA. Sands and any saturated clays would likely classify as Type C materials.

G.3. Dewatering

Water was not encountered in the borings during drilling and none of the samples returned appeared to be excessively wet. We would expect moisture to leach into and perch upon the less permeable clays and bedrocks. A sump pump and sump pit is expected to be capable of removing any moisture that accumulates within excavations.

G.4. Compaction

Fill should be placed in lifts adjusted to the compactor being used and the material being compacted. We recommend limiting lifts to no more than 2 feet for clean sands or gravels, and 1 foot for silty or clayey soils – assuming large, self-propelled or tow-behind compactors are used.

If site grading is anticipated during cold weather, we recommend that good winter construction practices be observed. All snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on soils that have frozen or contain frozen material. Frozen soils should not be used as fill.

G.5. Construction Testing and Documentation

Ideally, the bottom of all excavations should be evaluated and documented by qualified geotechnical personnel, after the unsuitable soils are removed from the structure areas, and before filling. Fill placed below building and paved areas should be evaluated for conformance to the project gradation recommendations and should be tested for compaction. If the filling proceeds during periods of freezing weather, full-time testing should be considered to help confirm that imported fill is thawed prior to and during compaction, and that all snow has been removed before placement of the fill.

Our firm offers testing services relating to civil and structural components of the structures (such as concrete testing, reinforcement observations, etc.) The project civil or structural engineer(s) should be consulted as to the need or requirements for such services.

H. Level of Care

The services provided for this project have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area, under similar budget and time constraints. This is our professional responsibility. No other warranty, expressed or implied, is made.

Appendix

Boring Location Sketch

Log of Boring # 1-3

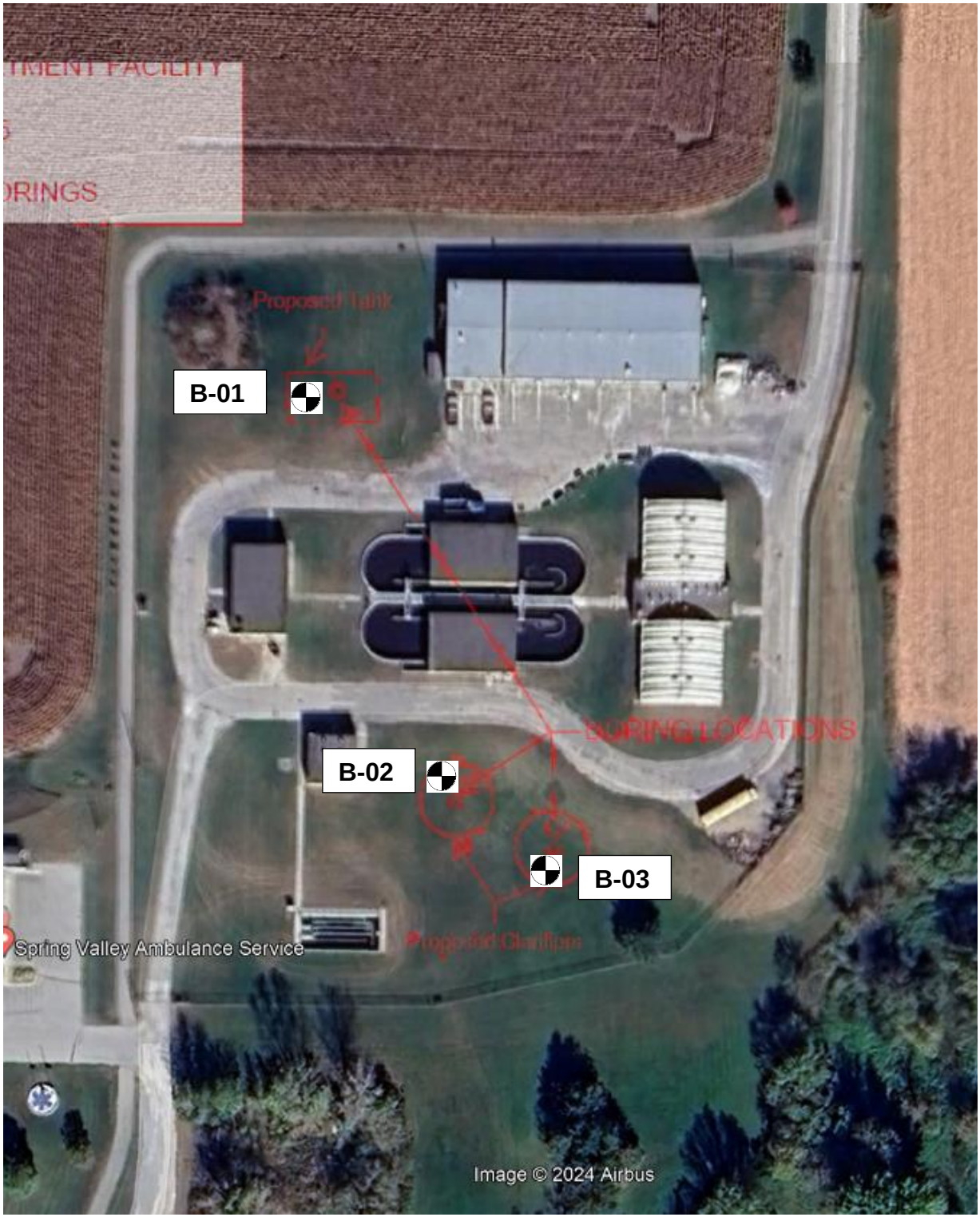
Legend to Soil Description

Chosen Valley Testing, Inc.

Boring Location Sketch

Proposed WWTF Improvements
900 E Farmer Street
Spring Valley, Minnesota
23482.24.MNR

Legend
- Boring Location



LOG OF BORING

CHOSEN VALLEY TESTING

Chosen Valley Testing, Inc.

PROJECT: 23482.24.MNR Design Phase Geotechnical Evaluation Proposed WWTF Improvements 900 E Farmer Street Spring Valley, Minnesota	BORING: **B-01** LOCATION: See attached sketch DATE: 6/17/2024 SCALE: 1" = 1'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1283.5	0.0	CL	**LEAN CLAY** trace of gravel, dark brown, wet. (Fill)			Elevations estimated from MN Topo.
1281.5	2.0	GC GM	**CLAYEY GRAVEL to SILTY GRAVEL** mostly fine grained, tan, moist, medium dense. (Weathered Limestone)	24		
1279.5	4.0	SM	**SILTY SAND with GRAVEL** mostly fine grained, trace of clay, tan, moist, medium dense. (Weathered Limestone)	21		
1277.0	6.5	GM	**SILTY GRAVEL** tan, moist, very dense. (Weathered Limestone)	*		* 50 = 6"
1276.0	7.5		Auger refusal at about 7.5 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 23482.24.MNR (SPRING VALLEY WWTF IMPROVEMENTS).GPJ LOG A GNNN06.GDT 7/8/24

LOG OF BORING

CHOSEN VALLEY TESTING

Chosen Valley Testing, Inc.

PROJECT: 23482.24.MNR Design Phase Geotechnical Evaluation Proposed WWTF Improvements 900 E Farmer Street Spring Valley, Minnesota	BORING: **B-02** LOCATION: See attached sketch DATE: 6/17/2024 SCALE: 1" = 1'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1275.3	0.0	CL	**LEAN CLAY** trace of gravel, dark brown, wet. (Fill)			Elevations estimated from MN Topo.
1273.3	2.0	CL	**SANDY LEAN CLAY** trace of gravel, brown to dark brown, wet, stiff to very stiff. (Fill)	14		PP = 3.25 tsf
1270.1	5.3	SM	**SILTY SAND** mostly fine grained, brown, moist, medium dense. (Residuum)	24		
1269.1	6.3	SP	**POORLY-GRADED SAND with GRAVEL** mostly fine grained, white, moist, very dense. (Weathered Limestone)	*		* 22 / 50 = 5"
1267.8	7.5		Auger refusal at about 7.5 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 23482.24.MNR (SPRING VALLEY WWTF IMPROVEMENTS).GPJ LOG A GNNN06.GDT 7/8/24

LOG OF BORING

CHOSEN VALLEY TESTING

Chosen Valley Testing, Inc.

PROJECT: 23482.24.MNR Design Phase Geotechnical Evaluation Proposed WWTF Improvements 900 E Farmer Street Spring Valley, Minnesota	BORING: **B-03** LOCATION: See attached sketch DATE: 6/17/2024 SCALE: 1" = 1'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1267.8	0.0	CL	**LEAN CLAY** trace of gravel, dark brown, wet. (Fill)			Elevations estimated from MN Topo.
1265.8	2.0	CL	**SANDY LEAN CLAY** trace of gravel, brown to dark brown, wet, rather stiff to stiff. (Fill)	9		PP = 2.75 tsf
1261.3	6.5	GP	**POORLY-GRADED GRAVEL with SAND** mostly fine grained, white, moist, very dense. (Weathered Limestone)	16 *		* 50 = 3"
1260.8	7.0		Auger refusal at about 7 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 23482.24.MNR (SPRING VALLEY WWTF IMPROVEMENTS).GPJ LOG A GNNN06.GDT 7/8/24

UNIFIED SOIL CLASSIFICATION (ASTM D-2487/2488)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	Cu>4 AND 1<Cc<3	GW	WELL-GRADED GRAVEL
			Cu>4 AND 1>Cc>3	GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	Cu>6 AND 1<Cc<3	SW	WELL-GRADED SAND
			Cu>6 AND 1>Cc>3	SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY
			PI>4 AND PLOTS<"A" LINE	ML	SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY
			PI PLOTS <"A" LINE	MH	ELASTIC SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT

Relative Proportions of Sand and Gravel

TERM	PERCENT
Trace	< 15
With	15 - 29
Modifier	> 30

Relative Proportions of Fines

TERM	PERCENT
Trace	< 5
With	5 - 12
Modifier	> 12

Grain Size Terminology

TERM	SIZE
Boulder	< 12 in.
Cobble	3 in. - 12 in.
Gravel	#4 sieve to 3 in.
Sand	#200 sieve to #4 sieve
Silt or Clay	Passing #200 sieve

SAMPLE TYPES

Hollow Stem

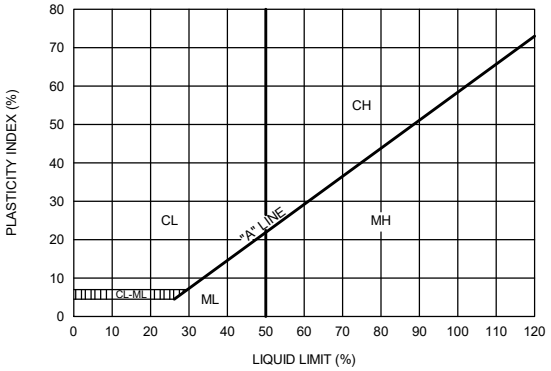
Standard Penetration Test

TEST SYMBOLS

MC	-	MOISTURE CONTENT	LL	-	LIQUID LIMIT
OC	-	ORGANIC CONTENT	PI	-	PLASTISITY INDEX
CN	-	CONSOLIDATION	SW	-	SWELL TEST
DD	-	DRY DENSITY	UU		Unconsolidated Undrained triaxial
PP	-	POCKET PENETROMETER			
RV	-	R-VALUE			
SA	-	SIEVE ANALYSIS			
P200	-	% PASSING #200 SIEVE			

- WATER LEVEL (WITH TIME OF) MEASUREMENT

PLASTICITY CHART



PENETRATION RESISTANCE
(RECORDED AS BLOWS / 0.5 FT)

SAND & GRAVEL		SILT & CLAY		
RELATIVE DENSITY	BLOWS/FOOT*	CONSISTENCY	BLOWS/FOOT*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 1	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 3	0.25 - 0.50
MEDIUM DENSE	10 - 30	RATHER SOFT	4 - 5	0.50 - 1.0
DENSE	30 - 50	MEDIUM	6 - 8	
VERY DENSE	OVER 50	RATHER STIFF	9 - 12	1.0 - 2.0
		STIFF	13 - 16	
		VERY STIFF	17 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

Chosen Valley Testing

Job No. 23831.24.IAM

LEGEND TO SOIL DESCRIPTIONS

CVT

Chosen Valley Testing, Inc.

CVT 23831.24.IAM (NEW CO-OP OSCEOLA FACILITY).GPJ 7/3/24

APPENDIX B

VALVE SCHEDULE

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Valve and Gate Schedule

City of Spring Valley

Wastewater Treatment Facility Improvements

BMI Project No. 0M2.131536

September 25, 2026

P&ID	TAG ID	LOCATION	SERVICE	TYPE	SIZE (IN)	ACTUATOR
5.03	SG-1	Preliminary Treatment Bldg	To Wet Well No. 1	Slide Gate	21" x 28"	Existing
5.03	SG-2	Preliminary Treatment Bldg	To Wet Well No. 2	Slide Gate	21" x 28"	Existing
5.03	SG-3	Preliminary Treatment Bldg	Wet Well No. 1 and No. 2	Sluice Gate	12" x 18"	Existing
5.03	SG-4	Preliminary Treatment Bldg	To Mechanical Fine Screen	Slide Gate	24" x 44"	Existing
5.03	SG-5	Preliminary Treatment Bldg	To Bypass Bar Screen	Slide Gate	24" x 33"	Existing
5.03	SG-6	Preliminary Treatment Bldg	From Mechanical Fine Screen	Slide Gate	24" x 36"	Existing
5.03	SG-7	Preliminary Treatment Bldg	From Bypass Bar Screen	Slide Gate	18" x 30"	Existing
5.03	SG-8	Preliminary Treatment Bldg	To Grit Collector	Slide Gate	21" x 36"	Existing
5.03	SG-9	Preliminary Treatment Bldg	To Bypass Channel	Slide Gate	18" x 36"	Existing
5.03	SG-10	Preliminary Treatment Bldg	From Grit Collector	Slide Gate	21" x 40"	Existing
5.03	SG-11	Preliminary Treatment Bldg	From Bypass Channel	Slide Gate	21" x 36"	Existing
5.03	SG-12	Control Structure No. 1	To Anoxic Basin No. 1	Slide Gate	72" x 18"	Crank
5.03	SG-13	Control Structure No. 1	To Anoxic Basin No. 2	Slide Gate	72" x 18"	Crank
5.03	SG-14	Anoxic Basin	Anoxic No. 1 / Anoxic No. 2	Slide Gate	24" x 24"	Crank
5.03	SG-15	Anoxic Basin	Anoxic No. 1 / Aeration No. 1A	Slide Gate	36" x 24"	Crank
5.03	SG-16	Anoxic Basin	Anoxic No. 2 / Aeration No. 2A	Slide Gate	36" x 24"	Crank
5.03	SG-17	Aeration Basin	Aeration No. 1B / Aeration No. 2B	Slide Gate	24" x 24"	Crank
5.04	SG-18	Control Structure No. 3	To Clarifier No. 1	Slide Gate	48" x 24"	Crank
5.04	SG-19	Control Structure No. 3	To Clarifier No. 2	Slide Gate	48" x 24"	Crank
5.04	SG-20	Disinfection Basin	To Chlorine Contact Basin No. 1	Slide Gate	12" x 18"	Crank
5.04	SG-21	Disinfection Basin	To Chlorine Contact Basin No. 2	Slide Gate	12" x 18"	Crank
5.05	V-A-1	Blower Building	Blower No. 1 - Isolation	Check	6	Existing
5.05	V-A-2	Blower Building	Blower No. 1 - Isolation	Butterfly	6	Existing
5.05	V-A-3	Blower Building	Blower No. 2 - Isolation	Check	6	Existing
5.05	V-A-4	Blower Building	Blower No. 2 - Isolation	Butterfly	6	Existing
5.05	V-A-5	Blower Building	Blower No. 3 - Isolation	Check	6	Existing
5.05	V-A-6	Blower Building	Blower No. 3 - Isolation	Butterfly	6	Existing
5.05	V-A-7	Blower Building	Blower No. 1 - Aeration Isolation	Butterfly	6	Existing
5.05	V-A-8	Blower Building	Blower No. 2 - Aeration Isolation	Butterfly	6	Existing
5.05	V-A-9	Blower Building	Blower No. 3 - Aeration Isolation	Butterfly	6	Existing
5.05	V-A-10	Blower Building	Blower No. 1 - Biosolids Isolation	Butterfly	6	Existing
5.05	V-A-11	Blower Building	Blower No. 2 - Biosolids Isolation	Butterfly	6	Existing
5.05	V-A-12	Blower Building	Blower No. 3 - Biosolids Isolation	Butterfly	6	Existing
5.05	V-A-13	Blower Building	Blower No. 4 - Isolation	Check	6	Existing
5.05	V-A-14	Blower Building	Blower No. 4 - Isolation	Butterfly	6	Existing
5.05	V-A-15	Blower Building	Blower No. 5 - Isolation	Check	6	Existing
5.05	V-A-16	Blower Building	Blower No. 5 - Isolation	Butterfly	6	Existing
5.05	V-A-17	Blower Building	Blower No. 6 - Isolation	Check	6	Existing
5.05	V-A-18	Blower Building	Blower No. 6 - Isolation	Butterfly	6	Existing

Valve and Gate Schedule

City of Spring Valley

Wastewater Treatment Facility Improvements

BMI Project No. 0M2.131536

September 25, 2026

P&ID	TAG ID	LOCATION	SERVICE	TYPE	SIZE (IN)	ACTUATOR
5.05	V-A-19	Blower Building	Blower No. 4 - Aeration Isolation	Butterfly	6	Existing
5.05	V-A-20	Blower Building	Blower No. 5 - Aeration Isolation	Butterfly	6	Existing
5.05	V-A-21	Blower Building	Blower No. 6 - Aeration Isolation	Butterfly	6	Existing
5.05	V-A-22	Blower Building	Blower No. 4 - Biosolids Isolation	Butterfly	6	Existing
5.05	V-A-23	Blower Building	Blower No. 5 - Biosolids Isolation	Butterfly	6	Existing
5.05	V-A-24	Blower Building	Blower No. 6 - Biosolids Isolation	Butterfly	6	Existing
5.05	V-A-25	Blower Building	Sludge Storage Tank Connection	Butterfly	6	Existing
5.05	V-A-26	Blower Building	Sludge Storage Tank No.1 Isolation	Butterfly	6	Existing
5.05	V-A-27	Blower Building	Sludge Storage Tank No. 2 Isolation	Butterfly	6	Existing
5.05	V-A-28	Blower Building	Aeration Basin Connections	Butterfly	10	Existing
5.05	V-A-29	Blower Building	Aeration Basin 1A/2A Isolation	Butterfly	10	Existing
5.05	V-A-30	Blower Building	Aeration Basin 1B/2B Isolation	Butterfly	10	Existing
--	V-A-31	Not Used	--	--	--	--
--	V-A-32	Not Used	--	--	--	--
5.03	V-A-33	Aeration Basin	Aeration Basin No. 2A	Butterfly	6	2-in Square Nut
5.03	V-A-34	Aeration Basin	Aeration Basin No. 2A	Butterfly	6	2-in Square Nut
5.03	V-A-35	Anoxic Basin	Anoxic Basin No. 2	Butterfly	6	2-in Square Nut
5.03	V-A-36	Anoxic Basin	Anoxic Basin No. 2	Butterfly	6	2-in Square Nut
5.03	V-A-37	Anoxic Basin	Anoxic Basin No. 1	Butterfly	6	2-in Square Nut
5.03	V-A-38	Anoxic Basin	Anoxic Basin No. 1	Butterfly	6	2-in Square Nut
5.03	V-A-39	Aeration Basin	Aeration Basin No. 1A	Butterfly	6	2-in Square Nut
5.03	V-A-40	Aeration Basin	Aeration Basin No. 1A	Butterfly	6	2-in Square Nut
5.03	V-A-41	Aeration Basin	Aeration Basin No. 2B	Butterfly	6	2-in Square Nut
5.03	V-A-42	Aeration Basin	Aeration Basin No. 2B	Butterfly	6	2-in Square Nut
5.03	V-A-43	Aeration Basin	Aeration Basin No. 1B	Butterfly	6	2-in Square Nut
5.03	V-A-44	Aeration Basin	Aeration Basin No. 1B	Butterfly	6	2-in Square Nut
5.04	V-A-45	Disinfection Bldg Blower Room	Reaeration Blower No. 7	Check	4	--
5.04	V-A-46	Disinfection Bldg Blower Room	Reaeration Blower No. 7	Butterfly	4	2-in Square Nut
5.04	V-A-47	Reaeration Basin	Blower No. 7 - Isolation	Butterfly	4	2-in Square Nut
5.05	V-PR-1	Blower Building	Blower No. 1 - Pressure Relief	Pressure Relief		Existing
5.05	V-PR-2	Blower Building	Blower No. 2 - Pressure Relief	Pressure Relief		Existing
5.05	V-PR-3	Blower Building	Blower No. 3 - Pressure Relief	Pressure Relief		Existing
5.05	V-PR-4	Blower Building	Blower No. 4 - Pressure Relief	Pressure Relief		Existing
5.05	V-PR-5	Blower Building	Blower No. 5 - Pressure Relief	Pressure Relief		Existing
5.05	V-PR-6	Blower Building	Blower No. 6 - Pressure Relief	Pressure Relief		Existing
5.04	V-PR-7	Disinfection Bldg Blower Room	Reaeration Blower No. 7	Pressure Relief	4	Blower Supplier
5.03	V-PD-1	Aeration Basins	Aeration Basin No. 1A Drain	Plug	6	Existing, Buried
5.03	V-PD-2	Aeration Basins	Aeration Basin No. 1B Drain	Plug	6	Existing, Buried
5.04	V-PD-3	Disinfection Basin	Mix Basin Drain	Plug	6	Existing, Buried

Valve and Gate Schedule

City of Spring Valley

Wastewater Treatment Facility Improvements

BMI Project No. 0M2.131536

September 25, 2026

P&ID	TAG ID	LOCATION	SERVICE	TYPE	SIZE (IN)	ACTUATOR
5.04	V-PD-4	Disinfection Basin	Disinfection Basin No. 1 Drain	Plug	6	Existing, Buried
5.04	V-PD-5	Disinfection Basin	Disinfection Basin No. 2 Drain	Plug	6	Existing, Buried
5.04	V-PP-1	Effluent Metering Station	Effluent Flow Meter (FE-2) Isolation	Plug	10	Valve Box, Stem Extension
5.04	V-PP-2	Effluent Metering Station	Effluent Flow Meter (FE-2) Isolation	Plug	10	Valve Box, Stem Extension
5.05	V-ST-1	Sludge Tank No.1 Isolation	Blower Building Basement	Plug	6	2-in Square Nut
5.05	V-ST-2	Sludge Tank No. 2 Isolation	Blower Building Basement	Plug	6	2-in Square Nut
5.05	V-ST-3	Sluge Tank Transfer Isolation	Blower Building Basement	Plug	6	2-in Square Nut
5.05	V-ST-4	Sludge Transfer Pump No.1 Check	Blower Building Basement	Check	6	--
5.05	V-ST-5	Sludge Transfer Pump No.1 Isolation	Blower Building Basement	Plug	6	2-in Square Nut
5.05	V-ST-6	Sludge Transfer Pump No.2 Check	Blower Building Basement	Check	6	--
5.05	V-ST-7	Sludge Transfer Pump No.2 Isolation	Blower Building Basement	Plug	6	2-in Square Nut
5.05	V-ST-8	Sludge Tank No. 1 Return	Blower Building Basement	Plug	6	Chainwheel
5.05	V-ST-9	Sludge Tank No. 2 Return	Blower Building Basement	Plug	6	Chainwheel
5.05	V-ST-10	Sludge Loadout	Waste Loadout Station	Plug	6	Chainwheel
5.05	V-ST-11	Sludge Loadout Meter	Waste Loadout Station	Plug	6	Chainwheel
5.05	V-ST-12	Sludge Overhead Loadout Isolation	Waste Loadout Station	Plug	6	2-in Square Nut
5.05	V-ST-13	Sludge Quick Loadout Isolation	Waste Loadout Station	Plug	6	2-in Square Nut
5.05	V-ST-14	Sludge to Plant Drain Isolation	Waste Loadout Station	Plug	6	2-in Square Nut
5.04	V-AR-1	Digester Building - Lower Level	RAS Air Relief - Clarifier No. 1	Air Relief	--	NA
5.04	V-AR-2	Digester Building - Lower Level	RAS Air Relief - Clarifier No. 2	Air Relief	--	NA
5.04	V-AR-3	Digester Building - Lower Level	Scum Air Relief	Air Relief	--	NA
5.03	V-AR-4	Digester Building - Lower Level	Mixed Liquor Return	Air Relief	--	NA
5.04	V-RAS-1	Clarifier No. 1 - Buried	Clarifier No. 1 - RAS Isolation	Plug	8	Valve Box, Stem Extension
5.04	V-RAS-2	Clarifier No. 2 - Buried	Clarifier No. 2 - RAS Isolation	Plug	8	Valve Box, Stem Extension
5.04	V-RAS-3	RAS Lift Station	RAS Wet Well Isolation	Plug	8	Valve Box, Stem Extension
5.04	V-RAS-4	Digester Building - Lower Level	RAS Pump 1 Check	Check	6	--
5.04	V-RAS-5	Digester Building - Lower Level	RAS Pump 1 Isolation	Plug	6	2-in Square Nut
5.04	V-RAS-6	Digester Building - Lower Level	RAS Pump 2 Check	Check	6	--
5.04	V-RAS-7	Digester Building - Lower Level	RAS Pump 2 Isolation	Plug	6	2-in Square Nut
5.04	V-RAS-8	Digester Building - Lower Level	RAS Pump 3 Check	Check	6	--
5.04	V-RAS-9	Digester Building - Lower Level	RAS Pump 3 Isolation	Plug	6	2-in Square Nut
5.04	V-RAS-10	Digester Building - Lower Level	RAS Pump 4 Check	Check	6	--
5.04	V-RAS-11	Digester Building - Lower Level	RAS Pump 4 Isolation	Plug	6	2-in Square Nut
5.04	V-RAS-12	Digester Building - Lower Level	RAS Flow Meter (FE-4) Isolation	Plug	8	Chainwheel
5.04	V-RAS-13	Digester Building - Lower Level	RAS Flow Meter (FE-4) Isolation	Plug	8	Chainwheel
5.04	V-WAS-1	Digester Building - Lower Level	WAS Flow Meter (FE-5) Isolation	Plug	4	2-in Square Nut
5.04	V-WAS-2	Digester Building - Lower Level	WAS Flow Meter (FE-5) Isolation	Plug	4	Chainwheel
5.04	V-WAS-3	Digester Building - Lower Level	WAS to Sludge Tank No. 1	Plug	4	Chainwheel
5.04	V-WAS-4	Digester Building - Lower Level	WAS to Sludge Tank No. 2	Plug	4	2-in Square Nut

Valve and Gate Schedule

City of Spring Valley

Wastewater Treatment Facility Improvements

BMI Project No. 0M2.131536

September 25, 2026

P&ID	TAG ID	LOCATION	SERVICE	TYPE	SIZE (IN)	ACTUATOR
5.05	V-SN-1	Digester Building - Lower Level	Sludge Tank No.1 Supernatant	Plug	6	Existing
5.05	V-SN-2	Digester Building - Lower Level	Sludge Tank No.1 Supernatant	Plug	6	Existing
5.05	V-SN-3	Digester Building - Lower Level	Sludge Tank No.1 Supernatant	Plug	6	Existing
5.05	V-SN-4	Digester Building - Lower Level	Sludge Tank No.1 Supernatant	Plug	6	Existing
5.05	V-SN-5	Digester Building - Lower Level	Sludge Tank No.1 Flow Meter (FE-6) Isolation	Plug	6	2-in Square Nut
5.05	V-SN-6	Digester Building - Lower Level	Sludge Tank No.1 Flow Meter (FE-6) Isolation	Plug	6	2-in Square Nut
5.05	V-SN-7	Digester Building - Lower Level	Sludge Tank No.2 Supernatant	Plug	6	Existing
5.05	V-SN-8	Digester Building - Lower Level	Sludge Tank No.2 Supernatant	Plug	6	Existing
5.05	V-SN-9	Digester Building - Lower Level	Sludge Tank No.2 Supernatant	Plug	6	Existing
5.05	V-SN-10	Digester Building - Lower Level	Sludge Tank No.2 Supernatant	Plug	6	Existing
5.05	V-SN-11	Digester Building - Lower Level	Sludge Tank No.2 Flow Meter (FE-7) Isolation	Plug	6	2-in Square Nut
5.05	V-SN-12	Digester Building - Lower Level	Sludge Tank No.2 Flow Meter (FE-7) Isolation	Plug	6	2-in Square Nut
5.04	V-SC-1	Clarifier No.1	Clarifier No.1 Scum Isolation	Plug	6	Stem Extension
5.04	V-SC-2	Clarifier No.2	Clarifier No.2 Scum Isolation	Plug	6	Stem Extension
5.04	V-SC-3	Digester Building - Lower Level	Scum Pump Check	Check	4	--
5.04	V-SC-4	Digester Building - Lower Level	Scum Pump Isolation	Plug	4	2-in Square Nut
5.04	V-HS-1	Clarifier No. 1 - Buried	Clarifier No. 1 - HS Isolation	Plug	6	Valve Box, Stem Extension
5.04	V-HS-2	Clarifier No. 2 - Buried	Clarifier No. 2 - HS Isolation	Plug	6	Valve Box, Stem Extension
5.04	V-UW-1	Disinfection Bldg Blower Room	Utility Water Pump No. 1	Check	3	--
5.04	V-UW-2	Disinfection Bldg Blower Room	Utility Water Pump No. 1	Plug	3	Lever
5.04	V-UW-3	Disinfection Bldg Blower Room	Utility Water Pump No. 2	Check	3	--
5.04	V-UW-4	Disinfection Bldg Blower Room	Utility Water Pump No. 2	Plug	3	Lever

APPENDIX C

MNRWA SEWER/WATER UTILITY – TRACE WIRE SPECIFICATION

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Sewer/Water Utility - Trace Wire Specification

Materials

General

All trace wire and trace wire products shall be domestically manufactured in the U.S.A.

All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

Trace wire

- **Open Trench -** Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.
- **Directional Drilling/Boring -** Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.
- **Trace wire – Pipe Bursting/Slip Lining -** Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness.

Connectors

- All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At Crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
- **Direct bury wire connectors** – shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
- Non locking friction fit, twist on or taped connectors are prohibited.

Termination/Access

- All trace wire termination points must utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.
- All grade level/in-ground access boxes shall be appropriately identified with “sewer” or “water” cast into the cap and be color coded.
- A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.
- All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
- Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

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Sewer/Water Utility - Trace Wire Specification

- **Service Laterals on public property** - Trace wire must terminate at an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway.
- **Service Laterals on private property** - Trace wire must terminate at an approved above-ground trace wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than 5 vertical feet above finished grade, or terminate at an approved grade level/in-ground trace wire access box, located within 2 linear feet of the building being served by the utility.
- **Hydrants** – Trace wire must terminate at an approved above-ground trace wire access box, properly affixed to the hydrant grade flange. (affixing with tape or plastic ties shall not be acceptable)
- **Long-runs, in excess of 500 linear feet without service laterals or hydrants** - Trace wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a minimum 48" polyethylene marker post, color coded per APWA standard for the specific utility being marked.

Grounding

- Trace wire must be properly grounded at all dead ends/stubs
- Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #12 red HDPE insulated copper clad steel wire connected to anode (minimum 1.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.
- When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.
- When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.
- Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

Installation

General

- Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
- Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.

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Sewer/Water Utility - Trace Wire Specification

- Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5' intervals.
- Trace wire must be properly grounded as specified.
- Trace wire on all service laterals/stubs must terminate at an approved trace wire access box located directly above the utility, at the edge of the road right-of-way, but out of the roadway. (See Trace wire Termination/Access)
- At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire. (See Grounding)
- Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.
- All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.
- In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.

Sanitary Sewer System

- A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.
- Lay mainline trace wire continuously, by-passing around the outside of manholes/structures on the North or East side.
- Trace wire on all sanitary service laterals must terminate at an approved trace wire access box color coded green and located directly above the service lateral at the edge of road right of way.

Water System

- A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.
- Lay mainline trace wire continuously, by-passing around the outside of valves and fittings on the North or East side.
- Trace wire on all water service laterals must terminate at an approved trace wire access box color coded blue and located directly above the service lateral at the edge of road right of way.
- Above-ground tracer wire access boxes will be installed on all fire hydrants.
- All conductive and non-conductive service lines shall include tracer wire.

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Sewer/Water Utility - Trace Wire Specification

Storm Sewer System

This section shall be included at the discretion of the facility owner.

- If the storm sewer system includes service laterals for connection of private drains and tile lines, it shall be specified the same as a sanitary sewer application.
- Lay mainline trace wire continuously, by-passing around the outside of manholes/structure on the North or East side.

Prohibited Products and Methods

The following products and methods shall not be allowed or acceptable

- Uninsulated trace wire
- Trace wire insulations other than HDPE
- Trace wires not domestically manufactured
- Non locking, friction fit, twist on or taped connectors
- Brass or copper ground rods
- Wire connections utilizing taping or spray-on waterproofing
- Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
- Trace wire wrapped around the corresponding utility
- Brass fittings with trace wire connection lugs
- Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
- Connecting trace wire to existing conductive utilities

Testing

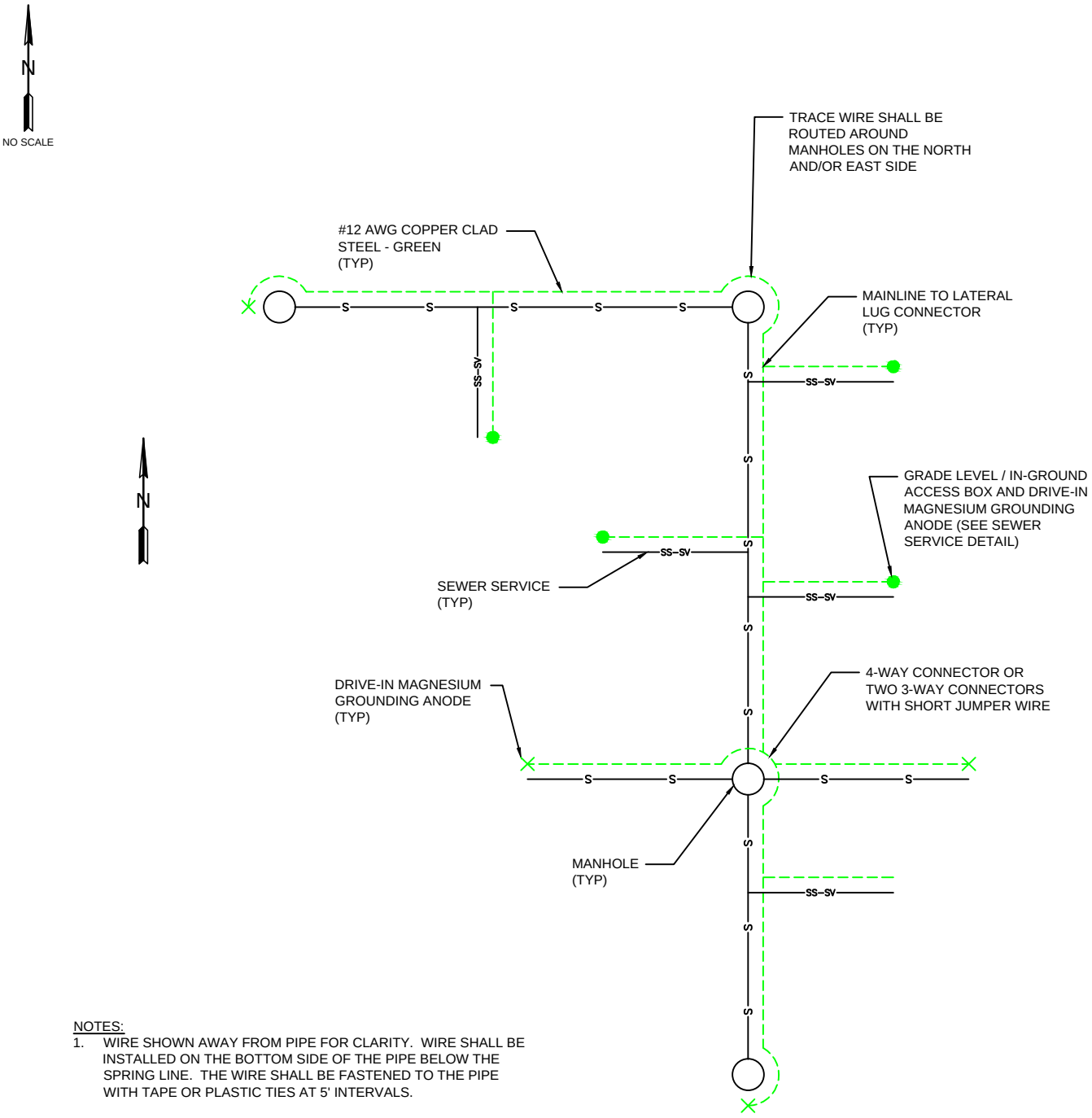
All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.

This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

Continuity testing in lieu of actual line tracing shall not be accepted.

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NOTES:

1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED ON THE BOTTOM SIDE OF THE PIPE BELOW THE SPRING LINE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.

TRACE WIRE PLAN (SEWER)

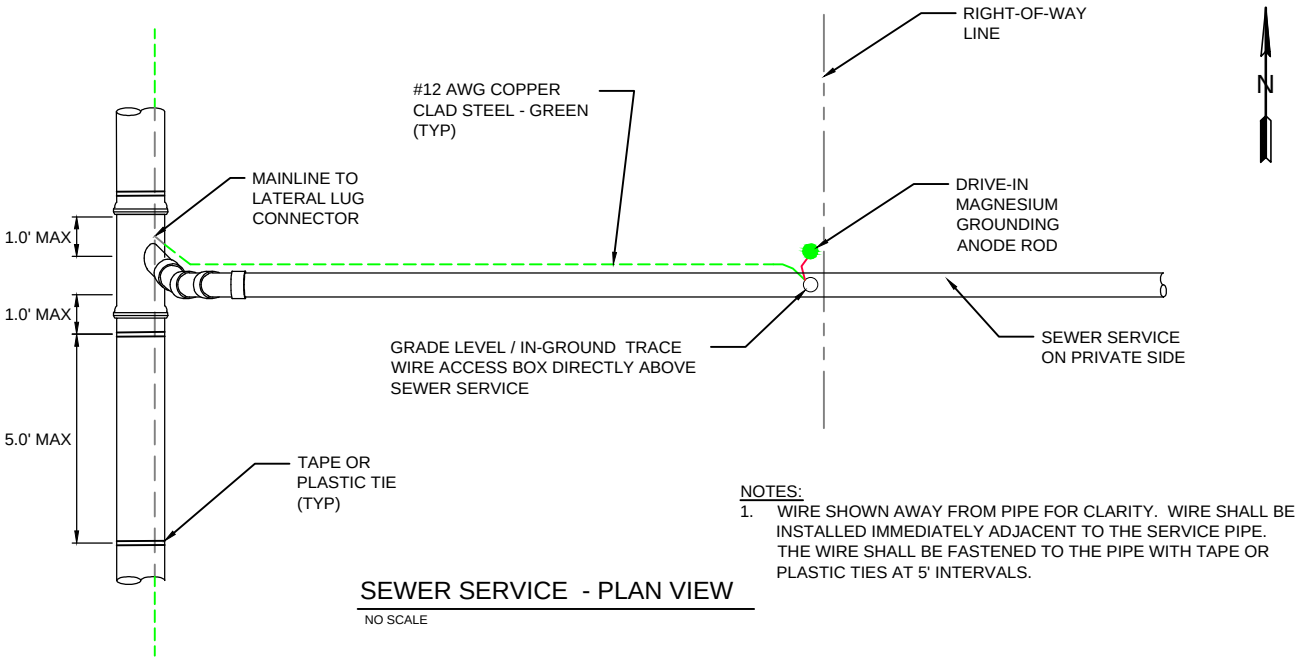
NO SCALE

MINNESOTA RURAL WATER ASSOCIATION
STANDARD DETAIL

TRACE WIRE
SAMPLE SEWER PLAN

May 28, 2014

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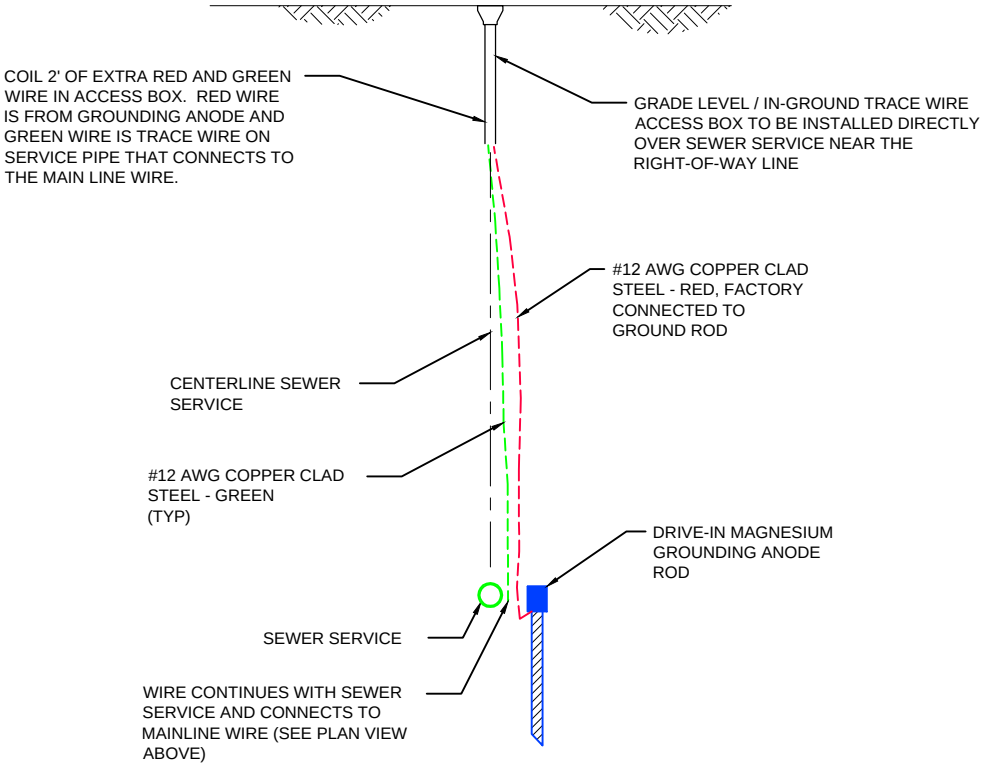


NOTES:

1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED IMMEDIATELY ADJACENT TO THE SERVICE PIPE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.

SEWER SERVICE - PLAN VIEW

NO SCALE



SEWER SERVICE - SECTION VIEW

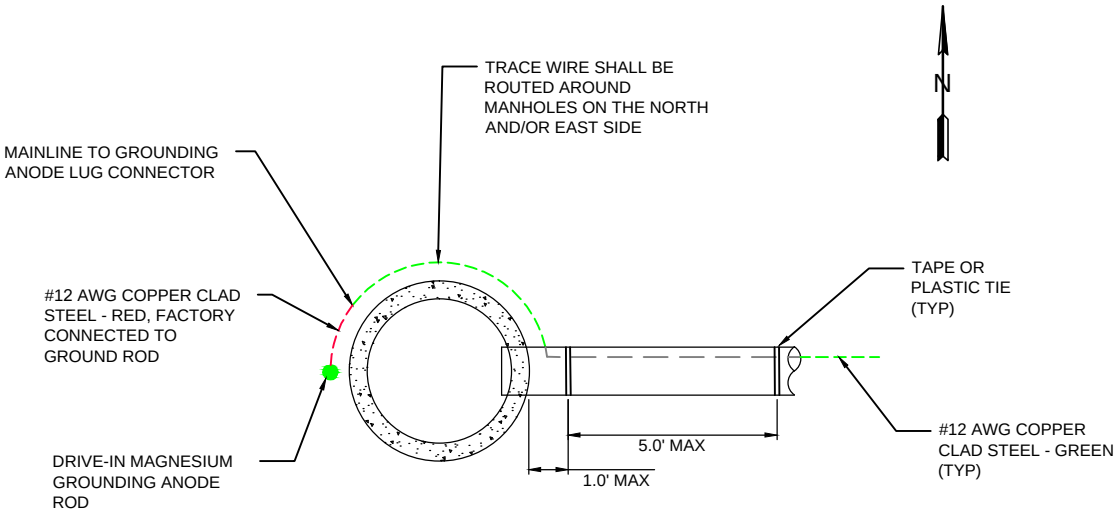
NO SCALE

MINNESOTA RURAL WATER ASSOCIATION
STANDARD DETAIL

TRACE WIRE
SEWER SERVICE DETAIL

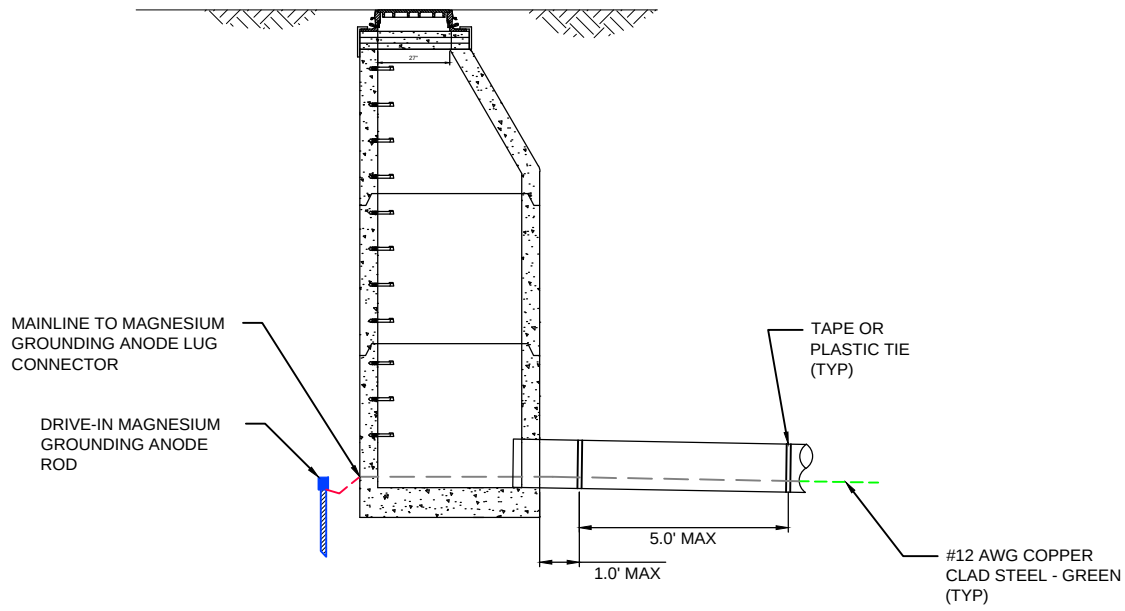
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SEWER MANHOLE - PLAN VIEW

NO SCALE



SEWER MANHOLE - SECTION VIEW

NO SCALE

MINNESOTA RURAL WATER ASSOCIATION
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TRACE WIRE
SEWER MANHOLE DETAIL

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