PROJECT MANUAL
FOR THE CONSTRUCTION OF

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS

SOUTH MILWAUKEE, WISCONSIN

VOLUME 1

Applied Technologies
Engineers - Architects

APRIL 2018

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NORTH CHICAGO LIFT STATION IMPROVEMENTS
CITY OF SOUTH MILWAUKEE, WISCONSIN

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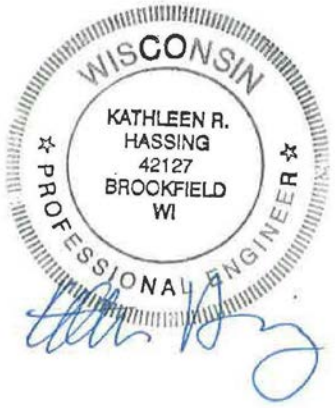

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INVITATION TO BID

NORTH CHICAGO LIFT STATION IMPROVEMENTS
CITY OF SOUTH MILWAUKEE, WISCONSIN

OWNER: The City of South Milwaukee hereby gives notice that sealed bids will be received for the construction of the North Chicago Lift Station.

TIME: Sealed Bids will be received until 2:00 p.m, local time, on Thursday, May 17th, 2018 at the office of the City Clerk at the City Hall, 2424 15th Avenue, South Milwaukee, Wisconsin, 53172 at which time all bids will be publicly opened and read aloud.

PROJECT: The Work, officially known as "North Chicago Lift Station Improvements", consists of construction of a new lift station to replace the existing station, including the construction of a new wet well, building, sewer, force mains, and demolition of the existing lift station. The work also includes sitework improvements, HVAC, electrical, instrumentation/controls, and other ancillary work required to accomplish the modifications.

BIDDING DOCUMENTS: The Bidding Documents are available for inspection at:

Engineer's Office:
Applied Technologies, Inc.
16815 West Wisconsin Avenue
Brookfield, Wisconsin 53005
(262) 784-7690

Complete digital copies of the Bidding Documents may be viewed and ordered online; see www.ati-ae.com/bidding-info or www.questcdn.com. Digital Bidding Documents may be downloaded for $10 by entering Quest Project No. 5692733 on the website's Project Search page. Please contact QuestCDN.com at 952-233-1632 or info@questcdn.com for assistance in working with the digital project information.

PREBID CONFERENCE: A prebid conference will not be held. Tours of the site may be arranged through the Owner.

SUBSURFACE INVESTIGATION REPORTS: Included in the Contract Documents.

WAGE RATES: Contractors are required to conform to the wage requirements prescribed by the federal Davis-Bacon and Related Acts, which requires that all laborers and mechanics employed by contractors and subcontractors performing on projects funded in whole or in part with federal assistance to be paid wages not less than the locally prevailing rates, as determined by the U.S. Department of Labor. Copies of the federal wage rate determination will be on file at the addresses listed for inspecting Bidding Documents and will be included in the Contract Documents.

OTHER PROVISIONS: The Contract letting shall be subject to the applicable provisions of the Wisconsin Statutes, Section 66.0901, 200.11, 779.15.

In connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employees or applicant for employment because of age, race, religion, color, handicap, sex, physical condition, developmental disability, or national origin. This provision shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff and termination; rates of pay or other forms of compensation; selection for training,

including apprenticeship. The Contractor further agrees to post in conspicuous places, available for employees and applicants for employment, notices setting forth the provisions of this non-discrimination clause.

The award of a Contract under this Invitation to Bid is contingent upon the Owner receiving a loan from the Wisconsin Clean Water Fund. This procurement will be subject to regulations contained in NR162, Wisconsin Administrative Code and appropriate State Statutes. Any contract awarded under this Invitation to Bid must demonstrate positive good faith efforts to utilize disadvantaged business enterprises (DBE), including women-owned business enterprises (WBE) and minority-owned business enterprises (MBE). DBE, including WBE and MBE, are encouraged to submit Bid Proposals. Prime bidders are strongly encouraged to submit an advertisement to an industry trade publication or regional newspaper to meet the good faith efforts required. Failure to comply with these provisions could result in bid rejection.

BID SECURITY: Bids shall be accompanied by a certified or bank check or a Bid Bond on the prescribed form payable to the Owner in an amount not less than 5% of the Total Base Bid as guarantee, that if the Bid is accepted, the Bidder will execute and file the Agreement, Performance and Payment Bonds, and Insurance Certifications, as required by the Contract Documents, within 15 days after the Notice of Award.

BID REJECTION/ACCEPTANCE: The Owner reserves the right to reject any and all Bids, waive any informalities in bidding or to accept the Bid or Bids, which best serve the interests of Owner.

BID WITHDRAWAL: No Bid shall be withdrawn for a period of 120 days after the scheduled opening of the Bids without the consent of the Owner.

Published by authority of the Commissioners of the City of South Milwaukee, Wisconsin.

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1. DEFINED TERMS.

1.1. 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:

1.2. Bidder – The individual or entity who submits a Bid directly to Owner.

1.3. Issuing Office – The office from which the Bidding Documents are to be issued.

1.4. Successful Bidder - The lowest, qualified, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

2. COPIES OF BIDDING DOCUMENTS

2.1. Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.

2.2. Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.3. Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

3. QUALIFICATIONS OF BIDDERS

3.1. To demonstrate Bidder’s qualifications to perform the Work, after submitting its Bid and within 5 days of Owner’s request, Bidder shall submit (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:

3.1.1. Evidence of Bidder’s authority to do business in the state where the Project is located.

3.1.2. Bidder’s state or other contractor license number, if applicable.

3.1.3. The address and description of the Bidder's place of business.

3.1.4. The number of years engaged in the contracting business under the present firm name, and the name of the state where incorporated.

3.1.5. A list of the property and equipment available to the Bidder to evaluate if the Bidder can complete the Work in accordance with the Bidding Documents.

3.1.6. A financial statement of the Bidder showing that the Bidder has the financial resources to meet all obligations incidental to the Work.

3.1.7. The Bidder's performance record giving the description, location, and telephone numbers of similar projects constructed in a satisfactory manner by the Bidder.

3.1.8. A list of projects presently under Contract, the approximate Contract amount, and percent of completion of each.

3.1.9. A list of Contracts that resulted in lawsuits.

3.1.10. A list of Contracts defaulted.

3.1.11. A statement of the Bidder indicating whether or not the Bidder has ever filed bankruptcy while performing Work of like nature or magnitude.

3.1.12. A list of officers of the firm who, while in the employ of the firm or the employ of previous firms, where associated with Contracts which resulted in lawsuits, Contracts defaulted or filed for bankruptcy.

3.1.13. The technical experience of personnel guaranteed to be employed in the responsible charge of the Work stating whether the personnel have or have not performed satisfactorily on other Contracts of like nature and magnitude or comparable difficulty at similar rate of progress.

3.1.14. Such additional information as will assist Owner in determining whether the Bidder is adequately prepared to fulfill the Contract.

3.1.15. Subcontractor and Supplier qualification information; coordinate with provisions of Article 12 of these Instructions, "Subcontractors, Suppliers, and Others."

3.2. The object of the request for the qualification of Bidder is not to discourage bidding or make it difficult for qualified Bidders to file Bids. Neither is it intended to discourage beginning Contractors. It is intended to make it possible for Owner to have exact information on financial ability, equipment, and experience in order to reduce the hazards involved in awarding Contracts to parties who may not be qualified to perform the Work as specified.

4. SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

4.1. Site and Other Areas

4.1.1. 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.

4.2. Existing Site Conditions

4.2.1. Subsurface and Physical Conditions; Hazardous Environmental Conditions

4.2.2. The Supplementary Conditions identify:

4.2.3. Those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.

4.2.4. Those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

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

4.2.6. Technical Data contained in such reports and drawings.

4.2.7. 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 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.

4.2.8. 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.

4.2.9. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

4.2.10. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.3. Site Visit and Testing by Bidders

4.3.1. Bidder shall conduct the required Site visit during normal working hours, and shall not disturb any ongoing operations at the Site.

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

4.3.3. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder 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.

4.3.4. Bidder shall 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.

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

4.4. Owner's Safety Program

4.4.1. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.5. Other Work at the Site

4.5.1. 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 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.

5. BIDDER'S REPRESENTATIONS

5.1. It is the responsibility of each Bidder before submitting a Bid to:

5.2. Examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;

5.3. Visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

5.4. Become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;

5.5. Carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;

5.6. Consider 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 Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;

5.7. Agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

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

5.9. Promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;

5.10. Determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and

5.11. Agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, 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. PRE-BID CONFERENCE

6.1. A pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

7. INTERPRETATIONS AND ADDENDA

7.1. All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.2. Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

8. BID SECURITY

8.1. 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 certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.

8.2. 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 Documents, 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 Documents 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. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.

8.3. 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 seven 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.

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

9. CONTRACT TIMES

9.1. The number of days within which, or the dates by which, the Work is to be substantially completed and ready for final payment are set forth in the Bid Form and will be included in the Agreement.

10. LIQUIDATED DAMAGES

10.1. 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.

11. SUBSTITUTE AND "OR-EQUAL" ITEMS

11.1. 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. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in Article 7 of the General Conditions and may be supplemented in Division 01 - General Requirements.

11.2. The Contract Documents have been prepared based on the use of certain materials and equipment from specific "named" manufacturers. Naming the manufacturer in the Contract Documents is intended to establish a minimum of the type, function, and quality required. Materials and equipment to be provided by the "named" manufacturers shall comply with all the requirements of the Contract Documents.

11.3. The "named" manufacturers for certain major equipment items are listed in Schedule A - Major Equipment Items, in the Bid Form. Identifying the manufacturer in Schedule A is intended to establish a common basis for all bids to ensure that the Owner receives the full benefit of any savings in cost that may be associated with "or equal" equipment from an alternate manufacturer. All Bidders are required to

include all the costs for furnishing the "named" manufacturer identified in Schedule A in the Total Base Bid. No change will be permitted in the selections in Schedule A after the opening of bids unless authorized by OWNER. The Bidder understands that after a contract is awarded, the OWNER may select items of any other manufacturer listed on Schedule. If awarded the contract, the Bidder agrees to provide the owner-selected equipment for the price indicated. The Base Bid amount will then be adjusted accordingly.

11.4. Bidders proposing to offer "or equal" major equipment from an alternate manufacturer must write the alternate manufacturer's name, model number, and the dollar amount for the alternate in the appropriate spaces provided in Schedule A - Major Equipment Items. If the Bidder proposes "or equal" major equipment he shall incorporate in the price for the alternate all additional costs for and be responsible for layout, piping, plumbing, mechanical, HVAC, structural, instrumentation and control, electrical, and all other changes to the Work required to incorporate the proposed alternate or "or equal" major equipment item(s) into the Work.

11.5. Proposed "or equal" major equipment will only be considered after the Effective Date of the Agreement. The successful Bidder shall submit to the Engineer within 7 days following the Effective Date of the Agreement a proposal containing two sets of drawings, specifications, detailed descriptive material listed below, and any additional materials listed in the specific specifications, for all proposed "or equal" major equipment items. The submittals for all proposed "or equal" major equipment shall be clearly identified by specification section and name of equipment. Failure to comply with these requirements shall be considered appropriate cause for rejection of the "or equal" proposal. No alternate will be considered unless it has been listed in the successful Bidder's Bid Schedule A - Major Equipment Items.

11.6. All prices that Bidder sets forth in its Bid shall 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.

11.7. "Or Equal" Major Equipment Submittal Requirements:

11.7.1. Complete description of the equipment, system, process or function, including a list of system components, features, dimensional, and weight information for separate components and assemblies, drawings, catalog information and cuts, manufacturer's specifications, including materials description.

11.7.2. Performance data and curves, and horsepower requirements.

11.7.3. Outside utility requirements for each component, such as water, power, air, control.

11.7.4. Functional description of any internal instrumentation and control supplied including list of parameters monitored, controlled, or alarmed.

11.7.5. Addresses and phone numbers of nearest service centers and a listing of the manufacturers or manufacturer's representatives services available at these locations, including addresses and phone numbers of the nearest parts warehouses capable of providing full parts replacement and/or repair services.

11.7.6. A list of the three most recent installations where similar equipment by the manufacturer or manufacturer's representative is currently in similar service; include contact name, telephone number, mailing address of the municipality or installation, Engineer, Owner, and installation contractor; if three installations do not exist, the list shall include all that do exist.

11.7.7. Detailed information on site, architectural, structural, mechanical, plumbing, HVAC, electrical, process instrumentation and control, and all other changes or modifications to the design and construction work necessary to adapt the equipment or systems to the arrangement shown and/or functions described on the Drawings and in the Specifications. This shall include plan view and section sketches illustrating any additional space requirements necessary to provide the minimum adequate clear space around the equipment for operation and maintenance, as shown on the Drawings.

11.7.8. Other specific submittal requirements listed in the Specifications.

11.7.9. All differences between the "named" equipment in the specifications and the proposed "or equal" equipment shall be clearly stated in writing under a heading of "Differences".

11.7.10. In submission of substitutions to Products specified, Bidders shall include in their Bid, changes required in the Work to accommodate such approved substitutions. Later claims by the Bidder for an addition to the Contract Time or Contract Price because of changes in Work necessitated by use of substitutions will not be considered.

11.8. Within 14 calendar days after receiving all proposed "or equal" major equipment submittals, the Engineer will notify, in writing, the Bidder as to whether or not the submitted proposed substitute or "or equal" major equipment, if any, are accepted by the Owner as meeting the specified requirements. The consideration of this equipment shall not be construed to relieve the successful Bidder and/or Manufacturer/Supplier of the equipment from providing the required construction submittal information.

11.8.1. To be deemed "or equal", the proposed equipment shall be the same or better than the specified named product with respect to features, materials of construction, function, performance, reliability, quality, general dimensional configuration, operation and maintenance costs, operations and maintenance access, and static and dynamic loads. Determination of equality in reference to the project design requirements will be made by the Engineer.

11.8.2. No proposed "or equal" major equipment will be considered unless, in the opinion of the Engineer, it conforms to the Contract Documents in all respects, except for make and manufacturer and minor details.

11.8.3. Requirements of Article7 of the General Conditions shall be enforced in the evaluation and/or implementation of proposed "or equal" equipment.

11.8.4. Should the proposed "or equal" item be determined "not equal" by the Engineer, then the Bidder shall agree to provide the "named" Manufacturer in Schedule A - Major Equipment Items, for the amount included in his Total Base Bid with NO change in price for that item.

11.8.5. For alternatives accepted by the Owner, the dollar amounts listed in Schedule A - Major Equipment Schedule shall be used to adjust the Total Base Bid Amount to revise the CONTRACT PRICE through a contract modification. The Owner reserves the right to accept or reject any proposed alternative.

12. SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.1. A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

12.2. Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.

12.3. When required by and in the manner provided on the Bid Form, Bidder shall list and identify those subcontractors, suppliers and other persons and organizations proposed for portions of the Work (including those who are to furnish the principal items of materials and equipment). After the bids are opened but before any award, any Bidder so requested shall submit to Owner such additional listing and identifications as Owner or Engineer may request.

12.4. For additional requirements regarding Subcontractors, Suppliers, and Others, refer to Article 7 of the General Conditions. Refer to the Supplementary Conditions for possible modifications to the paragraphs.

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

12.6. 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, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity 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 7.06 of the General Conditions.

13. PREPARATION OF BID

13.1. The Bid Form is included with the Bidding Documents.

13.1.2. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

13.1.3. 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."

13.2. A Bid by a corporation shall 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 shall be shown.

13.3. A Bid by a limited liability company shall 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 shall be shown.

13.4. A Bid by an individual shall show the Bidder's name and official address.

13.5. A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

13.6. All names shall be printed in ink below the signatures.

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

13.8. Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.

13.9. The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

14. BASIS OF BID

14.1. Total Base Bid

14.1.2. Bidders shall submit a Total Base Bid as set forth in the Bid Form, which includes the Sum of Extended Amounts for Unit Prices Bid plus all allowances, as well as major equipment provided by the "named" manufacturers listed in Schedule A – Major Equipment Schedule.

15. SUBMITTAL OF BID

15.1. With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of 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 7 of the Bid Form.

15.2. A Bid shall be received no later than the date and time prescribed and at the place indicated in the Invitation to Bid and shall be enclosed in a plainly marked package with the Project title, the name and address of Bidder, and shall 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 shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed as listed in the Invitation to Bid.

15.3. 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 and will be returned to the Bidder unopened.

16. MODIFICATION AND WITHDRAWAL OF BID

16.1. A 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.

16.2. If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.

16.3. 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, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

17. OPENING OF BIDS

17.1. 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. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

18. BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

19. EVALUATION OF BIDS AND AWARD OF CONTRACT

19.1. Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. 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, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.

19.2. Owner reserves the right to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner.

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

19.4. Evaluation of Bids

19.4.1. In evaluating Bids, Owner will consider whether or not 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.

19.4.2. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between written amounts and amounts in figures will be resolved in favor of the written amounts.

19.4.3. Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for portions of the Work as to which the identity of Subcontractor, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data are required to be submitted prior to the Notice of Award.

19.4.4. Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

19.4.5. If requested by the Owner, Bidder shall provide a complete breakdown of the Bid, listing separate prices for each Specification Division adding up to the TOTAL BASE BID.

19.4.6. If the Contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within the period of time specified in the Invitation to Bid after the day of the Bid opening. .

20. BONDS AND INSURANCE

20.1. 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 and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

21. SIGNING OF AGREEMENT

21.1. When Owner issues a Notice of Award to the Successful Bidder, it shall 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 shall 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 ten days thereafter, Owner shall 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.

22. SALES AND USE TAXES

22.1. Owner is exempt from Wisconsin state sales and use taxes on materials and equipment to be incorporated in the Work. (2015 Wisconsin Act 126). Said taxes shall not be included in the Bid. Refer to Paragraph SC-7.09 of the Supplementary Conditions for additional information.

23. WAGE RATES

23.1. The Contractor shall comply with all applicable federal, state, and local rules and regulations regarding the posting, certification, and filing of Wage Rates paid to employees. Refer to the Wage Rates section of the Contract Documents.

23.2. The state and federal prevailing Wage Rate determinations for this project are on file with the Owner and/or included in the Contract Documents.

23.3. Bids shall be submitted with a completed Disclosure of Ownership form that is included in the Wage Rates section of the Contract Documents.

24. EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS

24.1. In connection with the performance of Work under this Contract, Contractor agrees not to discriminate against any employee or applicant for employment because of age, race, religion, color, handicap, sex, physical condition, developmental disability or national origin as defined in Wisconsin Statutes. This provision shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractor further agrees to take affirmative action to ensure equal employment opportunities for persons with disabilities. Contractor agrees to post in conspicuous places, available for employees and applicants for employment, notices setting forth the provisions of the nondiscrimination clause, a copy of which is included in the Contract Documents.

25. DISADVANTAGED BUSINESS ENTERPRISE (DBE) REQUIREMENTS

25.1. The Owner anticipates receiving a loan from the Wisconsin Clean Water Fund. This procurement will be subject to regulations contained in NR 162. Failure to comply could result in the termination of the loan and/or could result in the contract being awarded to the lowest bidder demonstrating a positive effort to utilize women, minority, and small businesses.

25.2. The Contractor shall demonstrate positive efforts to utilize disadvantaged business enterprises (DBE), including women business enterprises (WBE) and minority-owned businesses (MBE). The Contractor's documentation regarding positive effort to utilize DBE shall be submitted with the Bid. Refer to DBE section of the Contract Documents. Utilize the forms enclosed therein to demonstrate good faith effort and DBE utilization. Completed forms must be included with the bid documents submitted at the time of Bid Opening.

25.3 Bidders may contact prospective DBE on the Wisconsin Unified Certification Program Eligibility Directory (available on the Wisconsin Department of Transportation’s website) to solicit bids from these firms. For contractors utilizing DBE the appropriate form must be submitted with the Bid to document the DBE subcontractors to be used in the Work.

26. OTHER PROVISIONS.

26.1. The Contract letting shall be subject to the applicable provisions of the Wisconsin Statutes, Section 66.0901.

26.2. The award of a Contract under this Invitation to Bid is contingent upon the Owner receiving a loan from the Wisconsin Clean Water Fund. This procurement shall be subject to regulations contained in NR 162, Wisconsin Administrative Code and appropriate State Statutes.

26.3 This project may be funded in whole or in part using funds from the Clean Water State Revolving Loan Fund. Federal law P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an "American Iron and Steel (AIS)" requirement in section 436 that requires the Clean Water State Revolving Fund assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. Bidders must certify that they have reviewed and understand the requirements for the use of AIS in the Work. See AIS section of the specifications.

BID FORM

NOTE: Use Black Ink Or Typewriter For Completing This Bid Form

PROJECT IDENTIFICATION: North Chicago Lift Station Improvements

THIS BID IS SUBMITTED TO: City of South Milwaukee
City Clerk
2424 15th Avenue
South Milwaukee, WI 53172

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with Owner in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. Bidder accepts all of the terms and conditions of the Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for the period of time specified in the Invitation to Bid after the day of Bid opening. Bidder will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within 15 days after the date of Owner's Notice of Award.

3. In submitting this Bid, Bidder represents, as more fully set forth in the Agreement, that:

(a) Bidder has examined copies of all the Bidding Documents and of the following Addenda, receipt of all which is hereby acknowledged:

Number	Date

(b) Bidder has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

(c) Bidder has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Article 5 of the General Conditions and accepts the determination set forth in Article 5 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which Bidder is entitled to rely.

(d) Bidder has obtained and carefully studied all such examinations, investigations, explorations, tests and studies which pertain to the subsurface or physical conditions at the site or otherwise may affect the cost, progress, performance or furnishing of the Work as Bidder considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Article 5 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports or similar information or data are or will be required by Bidder for such purposes.

(e) Bidder has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports or similar information or data in respect of said Underground Facilities are or will be required by Bidder in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Article 5 of the General Conditions.

(f) Bidder has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

(g) Bidder has given Engineer written notice of all conflicts, errors or discrepancies that it has discovered in the Contract Documents and the written resolution thereof by Engineer is acceptable to Bidder.

(h) This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

(i) Bidder has reviewed and understands the requirement for the use of American Iron and Steel (AIS) and certifies that all iron and steel products in the bid will be produced in the United States in a manner that complies with the AIS requirement.

(j) Bidder certifies that the Bid conforms to the requirements of Davis-Bacon labor standards and wage determinations.

4. Bidder will complete the Work for the following prices:

TOTAL BASE BID:

The Bidder agrees to complete the Total Base Bid work for each type and unit of work called for in the Contract Documents including the Sum of Extended Amounts and all allowances set forth in Section 01200, the major equipment provided by the "named" manufacturers listed in Schedule A - Major Equipment Schedule, and all other work called for in the Contract Documents for the following amount:

_____

(use words)

_____ Dollars $_____.____

(use figures)

If the Contract is to be awarded, it will be awarded to the lowest, qualified, responsive and responsible Bidder based on the TOTAL BASE BID whose evaluation by Owner indicates that the award will be in the best interests of the Project.

5. Bidder agrees that the Work will be substantially completed within 270 days from the date when the Contract Time commences to run as provided in Articles 4 and 15 of the General Conditions, and completed and ready for final payment in accordance with Article 15 of the General within 300 days from the date when the Contract Time commences to run.

Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work on time.

6. The following documents are attached to and made a condition of this Bid:

(a) Required Bid Security in the form of _____

(b) Schedule A - Major Equipment Schedule

(c) Schedule B - Subcontractor Listing

(d) Statement of the Bidder's qualification to do business in the state where the Project is located; or in the absence of such evidence, this bid constitutes Bidder's covenant to obtain such qualification prior to the award of the Contract.

(e) Disclosure of Ownership form (see Wage Rates).

(f) DBE Program Performance and Utilization Forms (EPA Forms 6100-4)

7. Communications concerning this Bid shall be addressed to:

Name: _____

Company Name: _____

Address: _____

Telephone No.: _____

8. The terms used in this Bid, which are defined in the General Conditions of the Construction Contract included as part of the Contract Documents, have the meanings assigned to them in the General Conditions.

SUBMITTED ON _____, 20_____

I hereby certify that as Bidder I/We have examined and carefully prepared this Bid from the Bidding Documents and have checked the same in detail before submitting this Bid, and that all statements herein are made on behalf of:

An Individual

By (Individual's Signature) _____ (SEAL)

Individual's Name (Print) _____

Doing business as (Firm Name) _____

Business address: _____

_____

_____

Phone No.: _____

A Partnership

By (Firm Name) _____ (SEAL)

Signature of General Partner _____

Name of General Partner (Print) _____

Business Address: _____

_____

_____

Phone No.: _____

A Corporation

By (Corporation Name) _____

State of Incorporation _____

Signature of Authorized Representative _____

Name of Authorized Rep. (Print) _____

Title _____ (SEAL)

Attest (Signature) _____

Name of Attester (Print) _____

Business address: _____

_____

_____

Phone No.: _____

A Joint Venture

By (Representative's Signature) _____ (SEAL)

Representative's Name & Title (Print) _____

Doing business as (Firm Name) _____

Business address: _____

_____

_____

Phone No.: _____

By (Representative's Signature) _____ (SEAL)

Representative's Name & Title (Print) _____

Doing business as (Firm Name) _____

Business address: _____

_____

_____

Phone No.: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above).

Sworn and subscribed to before me this

_____ day of _____, 20_____.

_____
Notary or Other Officer Authorized To
Administer Oaths

My commission expires: _____

SCHEDULE A MAJOR EQUIPMENT SCHEDULE					
Specification Section	Equipment Description	Named Manufacturers and Suppliers Included in Base Bid **(Circle the One Selected)**	Dollar Amount Included in Base Bid to Furnish Equipment/material **(Use Figures for the Selected One)**	Alternate ("Or Equal") Manufacturers and Suppliers (Fill in names)	Dollar Amount To Be Deducted From Base Bid if Alternative ("Or Equal") Is Chosen (Use Figures)
11316	Submersible Pumps	A. Flygt, Xylem	A. …….	B. ……	B. ……
13320	General Instrumentation and Controls	A. Allen-ICS B. Altronex C. Energenecs	A. ……. B. …….. C. ……..	D. ……	D. ……
16483	Adjustable Speed Controllers	A. Allen-Bradley B. Siemens C. Square-D	A. ……. B. …….. C. ……..	D. ……..	D. ……..
16621	Automatic Transfer Equipment	A. Russelectric, Inc. B. ASCO	A. ……. B. …….	C. ……	C. ……

SCHEDULE B
SUBCONTRACTOR LISTING

The Bidder certifies that the following firms or businesses will be awarded subcontracts for the indicated portions of the Work in the event that the Bidder is awarded the Contract. In addition to the subcontractors listed, fill in the names of all other subcontractors and suppliers whose contract amounts equal or exceeds 10% of the Total Base Bid Amount. The Bidder agrees that, after the opening of Bids, no changes or substitutions in the listing will be allowed without the written approval of the Owner. Requests for such changes or substitutions shall be made in writing with appropriate documentation and reasons included. If space is inadequate, attach additional sheets with identical information.

Mechanical Subcontractor

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Electrical Subcontractor

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Heating, Ventilating, & Air Conditioning Subcontractor

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Other

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Other

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Other

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Other

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

This page left intentionally blank.

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that _____

_____

hereinafter called the Principal (Bidder), and _____

a corporation duly organized and existing under the laws of the State of _____,

having its principal place of business at _____, and authorized to do

business in the State of Wisconsin, as Surety, are held and firmly bound unto the _____

_____

_____

hereinafter called the Obligee, in the penal sum of _____

_____ DOLLARS

($_____) for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS BOND IS SUCH THAT:

WHEREAS, the Principal is herewith submitting his or its Bid for:

_____

_____

_____

said Bid, by reference thereto, being hereby made a part hereof.

NOW, THEREFORE, if the Bid submitted by the Principal is accepted, and the Contract awarded to the Principal, and if the Principal shall execute the proposed Agreement and shall furnish such Performance Bond and Payment Bond as required by the Contract Documents within the time fixed by the Documents, then this obligation shall be void; if the Principal shall fail to execute the proposed Agreement and furnish the bonds, the Surety hereby agrees to pay to the Obligee the penal sum as liquidated damages.

Signed and sealed this _____ day of _____, 20_____.

[SEAL] _____
PRINCIPAL

_____ _____
WITNESS BY (TITLE)

[SEAL] _____
SURETY

_____ _____
WITNESS BY (TITLE)

AGREEMENT

THIS AGREEMENT is dated as of the _____ day of _____ in the year_____ by and between the City of South Milwaukee (hereinafter called Owner) and _____ (hereinafter called Contractor).

Owner and Contractor, in consideration of the mutual covenants hereinafter set forth, 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:

Furnish and install, complete, all labor, materials, equipment, tools, power, utilities, transportation, and all other items and services to perform construction of the complete project.

ARTICLE 2. THE PROJECT

2.01 The Project is generally described as follows:

The Work, officially known as "North Chicago Lift Station Improvements", consists of construction of a new lift station to replace the existing station, including the construction of a new wet well, building, sewer, force mains, and demolition of the existing lift station. The work also includes sitework improvements, HVAC, electrical, instrumentation/controls, and other ancillary work required to accomplish the modifications.

ARTICLE 3. ENGINEER

3.01 The project has been designed by Applied Technologies, Inc. who is hereinafter called Engineer and who is to act as Owner's representative, assume all duties and responsibilities and have the rights and authority assigned to Engineer in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE 4. CONTRACT TIMES

4.01 The Work will be substantially completed within 270 days from the date when the Contract Time commences to run as provided in Articles 2 and 14 of the General Conditions, and completed and ready for final payment in accordance with Article 14 of the General Conditions within 300 days from the date when the Contract Time commences to run.

4.02 Liquidated Damages.

A. Owner and Contractor recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They 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) Contractor shall pay Owner Two Hundred and 50/100 Dollars ($250.00) for each day that expires after the time specified above for Substantial Completion until the Work is substantially complete. After Substantial Completion if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner One Hundred and Fifty Dollars ($150.00) for each day that expires after the time specified above for completion and readiness for final payment.

ARTICLE 5. CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds as follows:

TOTAL BASE BID: _____

All specific cash allowances are included in the above price and have been computed in accordance with Article 13 of the General Conditions.

ARTICLE 6. PAYMENT PROCEDURES

6.01 Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 Progress Payments.

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Engineer, once each month during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in Article 2 of 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 in the General Requirements.

B. Prior to substantial completion, after each Application for Payment has been found acceptable by Owner, Owner will pay 95% of the estimated value less any previous payments to Contractor until the Project is 50% complete. At 50% completion, further partial payment shall be made in full to Contractor and no additional amounts may be retained unless Engineer certifies that the job is not proceeding satisfactorily, but amounts previously retained shall not be paid to Contractor. At 50% completion or any time thereafter when the progress of the Work is not satisfactory, additional amounts may be retained but in no event shall the total retainage be more than 10% of the value of the Work completed.

C. Upon substantial completion of the Work, an amount retained may be paid to the Contractor. When the work has been substantially completed except for Work which cannot be completed because of weather conditions, lack of materials or other reasons

which in the judgment of the Owner are valid reasons for non-completion, the Owner may make additional payments, retaining at all times an amount sufficient to cover the estimated cost of the Work still to be completed or in the alternative may pay out the entire amount retained and receive from the Contractor guarantees in the form of a bond or other collateral sufficient to ensure completion of the job.

6.03 Final Payment.

A. Upon final completion and acceptance of the Work in accordance with Article 14 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Article 15.

ARTICLE 7. INTEREST

7.01 All moneys not paid when due as provided in Article 15 of the General Conditions shall bear interest at the annual rate of 5%.

ARTICLE 8. CONTRACTOR'S REPRESENTATIONS

8.01 In order to induce Owner to enter into this Agreement Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may in any manner may affect cost, progress, performance or furnishing of the Work.

C. Contractor is familiar with and is satisfied as to all federal, state, and local laws and regulations that may in any manner may affect cost, progress, performance or furnishing of the Work.

D. Contractor has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Article 5 of the General Conditions, and accepts the determinations set forth in Article 5 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which Contractor is entitled to rely.

E. Contractor has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as Contractor considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Article 5 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by Contractor for such purposes.

F. Contractor has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said Underground Facilities are or will be required by Contractor in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Article 5 of the General Conditions.

G. Contractor has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

H. Contractor has given Engineer written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by Engineer is acceptable to Contractor.

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

ARTICLE 9. CONTRACT DOCUMENTS

9.01 The Contract Documents, which comprise the entire agreement between Owner and Contractor concerning the Work, consist of the following:

A. This Agreement (pages 00505-1 to 00505-6, inclusive).

B. Exhibits to this Agreement (pages _____ to _____, inclusive).

C. Performance and Payment Bonds, identified as exhibits 00610 and 00615 and consisting of six (6) pages.

D. Notice of Award (not attached).

E. General Conditions (pages 00700-1 to 00700-66, inclusive, not attached).

F. Supplementary Conditions (pages 00800-1 to 00800-10, inclusive, not attached).

G. Specifications consisting of Divisions and pages listed in Table of Contents of the Project Manual (not attached).

H. Drawings, consisting of sheets numbered 10-G-1 through 99-E-1, inclusive, (not attached) with each sheet dated, April 2018, and bearing the following general title:

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

I. Addenda numbers _____ to _____, inclusive (not attached).

J. Instructions to Bidders (pages 00200-1 to 00200-10 , inclusive, not attached).

K. Contractor's Bid (pages 00410-1 to 00410-10 including Schedules: A and B , inclusive).

L. Documentation submitted by Contractor prior to Notice of Award (pages _____ to _____, inclusive, not attached.).

M. The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to Article 11 of the General Conditions.

9.02 The documents listed in paragraphs 9.01.A et seq. above are attached to this Agreement (except as expressly noted otherwise above).

9.03 There are no Contract Documents other than those listed in this Article 9. The Contract Documents may only be amended, modified or supplemented as provided in Article 11 of the General Conditions.

ARTICLE 10. MISCELLANEOUS

10.01 Terms used in this Agreement will have the meanings indicated in the General Conditions.

10.02 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are 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 Documents.

10.03 Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 Any provision or part of the Contract Documents held to be void or unenforceable under any law or regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall 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.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement in triplicate. One counterpart each has been delivered to Owner, Contractor and Engineer. All portions of the Contract Documents have been signed or identified by Owner and Contractor.

This Agreement will be effective on _____ .

Owner _____

By _____
[SEAL]

Attest _____

Address for giving notices

_____

_____

_____

Contractor_____

By _____
[SEAL]

Attest _____

Address for giving notices

_____

_____

_____

(If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Agreement.

License No. _____
(where applicable)

Agent for service of process: _____

_____
(If Contractor is a corporation, attach evidence of authority to sign.)

Designated Representative:

Name: _____

Title: _____

Address: _____

Phone: _____

Facsimile: _____

Email: _____

Designated Representative:

Name: _____

Title: _____

Address: _____

Phone: _____

Facsimile: _____

Email: _____

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PERFORMANCE BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

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

CONTRACTOR AS PRINCIPAL

_____ *(seal)*
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ *(seal)*
Surety's Name and Corporate Seal

By: _____
Signature *(attach power of attorney)*

_____
Print Name

_____
Title

Attest: _____
Signature

_____
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 shall be 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 shall 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 shall 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 shall 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 shall 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 shall 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:

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 shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall 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 shall not be reduced or set off on account of any such unrelated obligations. No right of action shall 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 may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall 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 shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall 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 shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

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 shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND

Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

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

CONTRACTOR AS PRINCIPAL

_____ *(seal)*
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ *(seal)*
Surety's Name and Corporate Seal

By: _____
Signature *(attach power of attorney)*

_____
Print Name

_____
Title

Attest: _____
Signature

_____
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 shall be 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 shall 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 shall 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 shall 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.
8. The Surety's total obligation shall 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 shall 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 shall 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 satisfy 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 shall 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 shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall 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 shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall 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:
      1. The name of the Claimant;
      2. The name of the person for whom the labor was done, or materials or equipment furnished;
      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;
      4. A brief description of the labor, materials, or equipment furnished;
      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;
      6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
      7. The total amount of previous payments received by the Claimant; and
      8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

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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 shall be 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 shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

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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

Issued and Published Jointly by

EJCDC® C-700, Standard General Conditions of the Construction Contract.
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These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions 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's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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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 form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting 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, or both; 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, or both; contesting an initial decision by Engineer concerning the 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; or (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

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regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. 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), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree 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 the 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. *Engineer*—The individual or entity named as such in the Agreement.

21. *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.

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

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

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

25. *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.

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

27. *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.

28. *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.

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

30. *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.

31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

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

33. *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.

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

35. *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.

36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and

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submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *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 furnished by Owner which are designated for the use of Contractor.

38. *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.

39. *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.

40. *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 thereof.

41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.

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

43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, 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.

44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

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

47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the

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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.

48. *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.

1.02 *Terminology*

A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*:

1. 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*:

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*:

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

a. does not conform to the Contract Documents; or

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

c. 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 15.04).

E. *Furnish, Install, Perform, Provide*:

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean 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.

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2. The word “install,” when used in connection with services, materials, or equipment, shall mean 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, shall mean 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.

F. 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 Bonds and Evidence of Insurance*

A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), 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 executed 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 specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

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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 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 *Initial 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 for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall 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.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

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B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items 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 items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one 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 or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall 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.

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, shall mean 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, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, 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, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

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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 Documents 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 Documents 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 shall 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 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 thereunder.

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

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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 give written notice to Owner and Contractor 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 editions, 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 shall preclude 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 thirtieth 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 sixtieth day after the day of Bid opening or the thirtieth 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 shall 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 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

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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 shall 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 shall 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 the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the 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. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall 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 utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and

4. acts of war or terrorism.

D. 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

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with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs 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.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times 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.

G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor 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.

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; 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 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with

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such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; 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 shall 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 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 known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); 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 upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. 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; or

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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.

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 either:

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; or

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

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 the necessity of Owner's obtaining 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 above; 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. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, 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 Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

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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 conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

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; or

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 as 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, or both, then any such adjustment shall 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, or both, 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.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

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

b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;

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

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d. 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 in the Contract Documents, or was not shown or indicated 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), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

C. *Engineer's Review*: Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; 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 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. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, 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. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;

   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;

   c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and

   d. 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, or both, then any such adjustment shall be set forth in a Change Order.

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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, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

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

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

2. 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 Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. 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; or

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

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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, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, 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.

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 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 or 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.H shall obligate 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 shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

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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 all of Contractor's obligations under the Contract. These bonds shall 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 Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, 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 shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

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

D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.

E. 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.

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

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

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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. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements 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 and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements 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 and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

E. 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, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

F. If either party does not purchase or maintain all of 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.

G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.

H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect 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 shall be adjusted accordingly.

I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.

J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

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6.03 *Contractor's Insurance*

A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.

2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).

3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).

B. *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:

1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.

2. claims for damages insured by reasonably available personal injury liability coverage.

3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage:

a. Such insurance shall 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, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.

3. Broad form property damage coverage.

4. Severability of interest.

5. Underground, explosion, and collapse coverage.

6. Personal injury coverage.

7. 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); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.

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8. 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.

D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims 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 shall be written on an occurrence basis.

E. *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. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.

F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.

H. *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 shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:

1. include at least the specific coverages provided in this Article.

2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.

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4. remain in effect at least until final payment (and longer if expressly required in this Article) 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 Documents.

5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed 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.

J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

B. 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.

6.05 *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 full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."

2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available

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under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
6. extend to cover damage or loss to insured property while in transit.
7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
8. allow for the waiver of the insurer's subrogation rights, as set forth below.
9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
10. not include a co-insurance clause.
11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
12. include performance/hot testing and start-up.
13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. *Notice of Cancellation or Change*: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed 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.

C. *Deductibles*: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.

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

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provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

E. *Additional Insurance*: 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 6.05, it may do so at Contractor's expense.

F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. 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 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 Subcontractors, all individuals or entities identified in the Supplementary Conditions as 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. None of the above waivers shall extend 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. 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:

1. loss 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 perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner 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.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of

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recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work 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 any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 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 6.05 shall 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, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

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

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

7.02 *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 at all times maintain good discipline and order at the Site.

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B. 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 shall 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.

7.03 *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 shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall 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 shall 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.

7.04 *"Or Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, 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 material or equipment, or items from other proposed suppliers under the circumstances described below.

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

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

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

2) it 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;

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

4) it is not objectionable to Owner.

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

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

2) it 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 shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

A. Unless the specification or description of an item of material or equipment 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 material or equipment under the circumstances described below. To the extent possible such requests shall 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 material or equipment from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

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

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a. shall 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 that specified, and

3) be suited to the same use as that 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 that specified, and

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

d. shall 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.

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

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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 shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.

B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities 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, Supplier, or other individual or entity 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 five days.

E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. 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, Suppliers, or other individuals or entities 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, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, 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, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

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

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J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

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

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

N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor

2. shall create 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.

7.07 *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 a particular 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 shall be disclosed by Owner 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.

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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.

7.08 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. 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

7.09 *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.

7.10 *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. Except where otherwise expressly required by applicable Laws and Regulations, 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 shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Owner or Contractor may give 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 notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

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7.11 *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.

7.12 *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. 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.

B. 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. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when 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.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. 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.

E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.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

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Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

G. Contractor's duties and responsibilities for safety and protection shall 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.

7.13 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of 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 threatened 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 thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements*:

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

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

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified 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

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

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2. Each submittal shall 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.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings*:

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

b. Data shown on the Shop Drawings will 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.D.

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.D.

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. *Other Submittals*: Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review*:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. 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, conform to the information given in 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.

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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 shall 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 document any such approved variation from the requirements of the Contract Documents in a Field Order.

5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 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, shall 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, Sample, or other submittal shall 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.D.4.

E. *Resubmittal Procedures*:

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 submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

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

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 and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.

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

1. abuse, modification, or improper 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.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

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. any inspection, test, or approval by others; or

8. any correction of defective Work by Owner.

D. 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 shall 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 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 performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury 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 shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for

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Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.

B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

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.

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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 utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. 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.

D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, 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.

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 at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner 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, or both. 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 shall take into account

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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. When applicable, any such equitable adjustment in Contract Price shall 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 is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

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. 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 to 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.

C. 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 to Contractor.

D. 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 shall be that of the former Engineer.

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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.

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 Documents (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.

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B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

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 10.08. 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 *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 Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

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B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.

C. Engineer's authority as to Change Orders is set forth in Article 11.

D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *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.

10.07 *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.

10.08 *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, shall 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 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 10.08 shall also apply to the Resident Project Representative, if any.

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10.09 *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 (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. *Change Orders*:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not 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, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.

2. *Work Change Directives*: 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 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: 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. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *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. Such changes shall be supported by Engineer's recommendation, to the extent the change

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involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes 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 shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate 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.

11.03 *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.

11.04 *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 shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

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); or

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 11.04.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 11.04.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall 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 shall be 15 percent;

b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five 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 11.01.C.2.a and

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11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.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 five 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 shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

d. no fee shall 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 will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *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 shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures*: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. 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. The supporting data shall 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. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. *Engineer's Action*: Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole,

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approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change 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.

3. *Binding Decision*: Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

B. *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 that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. changes in the 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 11.02, (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 in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *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.

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ARTICLE 12 – CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor shall be submitted 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; and

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.

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 shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, 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 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 shall 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 shall 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 shall 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 shall 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 shall 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,

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the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall 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 shall be incorporated in a Change Order 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

2. 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 shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall 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. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, 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, shall 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 shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

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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, who 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 shall 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 for services specifically related to the Work.

5. Supplemental costs including 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, and hand tools not owned by the workers, which are 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.

    c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the 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 property insurance established in accordance with Paragraph 6.05), 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 shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

    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.

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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 shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety 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. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. 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.

5. 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*: When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

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 on account of any of the foregoing will be valid.

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C. *Contingency Allowance*: Contractor agrees that a 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 on account of Work covered by allowances, and the Contract Price shall 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 thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.

E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

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 will 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 therewith as applicable.

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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 shall 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.

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 shall 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 shall 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.

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C. *Notice of Defects*: Prompt 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, 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 shall 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 special 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.

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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, or both, 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, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall 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 rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven 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.

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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 on account of 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. 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 shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and 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.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. 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

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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.

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, or

   b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

   c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

   d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, 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.

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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 on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of 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;

    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 that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

    j. liquidated 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;

    l. there are other items entitling 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

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imposed shall 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 shall be treated as an amount due as determined by Paragraph 15.01.C.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 seven 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 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 shall 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 seven 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

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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 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 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 6.05 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

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inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall 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.

   d. a list of all disputes that Contractor believes are unsettled; 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 Application and Acceptance*:

1. 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 ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall 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. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. 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. *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.

D. *Payment Becomes Due*: Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer

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(less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.

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 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 terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then 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 other adjacent areas;

2. correct such defective Work;

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, 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 therefrom.

B. If 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 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 correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

C. 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.

D. 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

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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.

E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not 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, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall 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) ten 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) 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 seven 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,

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losses, and damages (including but not limited to all fees and charges of engineers, architects, 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 shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

A. Upon seven 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 on account of loss of anticipated overhead, profits, or revenue, 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 seven 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, seven days after written notice to Owner and Engineer, stop the

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Work until payment is made of all such amounts due Contractor, including interest thereon. The 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; and

2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising 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; or

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 Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

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.

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

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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 shall not constitute a waiver of that provision, nor shall 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 or completion of the Contract or termination 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 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the General Conditions of the Construction Contract (EJCDC No. C-700, latest Edition) and other provisions of the Contract Documents as indicated below. All provisions that are not so amended or supplemented remain in full force and effect.

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 thereto.

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

The terms used in these Supplementary Conditions, which are defined in the Standard General Conditions of the Construction Contract, have the meanings assigned to them in the General Conditions.

SC-1.01 Amend the definition entitled "Engineer" by adding the following language:

Whenever the word Architect or Architect/Engineer is used in the Specifications, it shall have the same meaning as the word Engineer as defined in this definition.

ARTICLE 2 - PRELIMINARY MATTERS

SC-2.02. Revise the first sentence of Paragraph 2.02.A. of the General Conditions to read "…one printed copy of the Contract…".

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.01. Amend the last sentence of Paragraph 4.01.A. of the General Conditions to read as follows:

In no event will the Contract Times commence to run later than the 120th day after the day of Bid opening or the thirtieth day after the effective date of the Contract, whichever date is earlier.

ARTICLE 5 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 Add the following language at the end of paragraph 5.03.A of the General Conditions:

The following reports of Explorations and tests of subsurface conditions at the site of work:

Geotechnical Engineering Exploration and Analysis
Proposed Lift Station
South Milwaukee, Wisconsin
Prepared By: Giles Engineering Associates, Inc.
June 16, 2016
Giles Project No. 1G-1605002

Copies of the Reports are included with Bidding Documents. These reports are not part of the Contract Documents, but the technical data contained therein upon which Contractor is entitled to rely as provided in Article 5 of the General Conditions are incorporated therein by reference.

ARTICLE 6 - BONDS AND INSURANCE

SC-6.01. Add the following language at the end of paragraph 6.01.D of the General Conditions:

In addition, no further progress payments under the Agreement will be made by the Owner until Contractor complies with the provisions of this paragraph.

SC-6.03. The limits of liability for the insurance required by paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

6.03.A. Workers' Compensation, under paragraph 6.03.A. of the General Conditions:

(1.) Workmen's compensation (Including coverage under United States Longshoremen's and Harbor Workers Act, where applicable)

	Statutory
Employer's Liability	
Bodily injury, each Accident	$100,000
Bodily injury by disease, each employee	$100,000
Bodily injury / disease aggregate	$500,000

A waiver of Subrogation in Favor of the City is required.

6.03.B., 6.03.C. Commercial General Liability under paragraphs 6.03.B. and 6.03.C. of the General Conditions (A waiver of Subrogation in Favor of the City is required.):

(2.) Coverage to include premises operations, product and completed operations, and the explosion (x), collapse (c), and underground property damage (u) hazard exposures, all subject to the following limits:

Each Occurrence (Bodily Injury and Property Damage)	$1,000,000
Personal and Advertising Injury (per person/organization)	$1,000,000
Products – Completed Operations Aggregate	$2,000,000
General Aggregate (other than products and completed operations)	$2,000,000

6.03.D. Automobile Liability under paragraphs 6.03.D of the General Conditions:

(3.) Automobile Liability coverage to include operations of owned, hired, and non-owned motor vehicles, all subject to a combined single limit of not less than $1,000,000 per occurrence for bodily injury and property damage.

6.03.E. Umbrella or Excess Liability under paragraphs 6.03.E. of the General Conditions:

(4.) Liability insurance may be arranged by Commercial General Liability and Automobile Liability policies for the full limits required, or by a combination of underlying policies for the lesser limits with the remaining limits provided by an Excess or umbrella policy:

Per Occurrence	$5,000,000
General Aggregate	$5,000,000

6.03.H. Contractor's Professional Liability under paragraph 6.03.H. of the General Conditions:

(5.)	Each Claim	$1,000,000
	Annual Aggregate	$1,000,000

SC-6.04. Owner's Liability Insurance:

Delete paragraph 6.04. of the General Conditions in its entirety and insert the following in its place:

6.04.A. The Contractor shall include the Owner and its subsidiaries and the Engineer by endorsement as additional insureds under the Contractor's General Liability Policy and Umbrella Liability Policies.

SC-6.05. Delete paragraph 6.05.A. of the General Conditions in its entirety and insert the following in its place:

6.05.A. CONTRACTOR shall purchase and maintain until final payment property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER and Engineer's consultants in the Work (all of whom shall be listed as insureds or additional insured parties), shall insure against the perils of fire and extended coverage, shall include "all-risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in these Supplementary Conditions, and shall include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all-risk" insurance or otherwise provided in these Supplementary Conditions, CONTRACTOR shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment. The policies of insurance to be purchased and maintained by CONTRACTOR in accordance with this paragraph 6.05.A. shall comply with the requirements of paragraph 6.03 of the General Conditions.

SC-6.06. In paragraph 6.06.A. of the General Conditions, replace the opening words to the second sentence "Owner and Contractor waive all rights against each other…" with "Contractor waives all rights against Owner…".

Delete paragraphs 6.06.B and 6.06.C of the General Condition in their entirety.

ARTICLE 7 - CONTRACTOR'S RESPONSIBILITIES

SC-7.06 Add a new paragraph immediately after paragraph 7.06.E of the General Conditions which is to read as follows:

7.06.E.1. Schedule B - Subcontractor Listing, shall be completed and included with the Bid Form at the time of Bid Opening.

Within seven (7) days following Bid Opening and before Notice of Award, the apparent successful bidder shall, in addition to Schedule B, provide a listing that identifies all subcontractors, suppliers, and manufacturers, that are to provide labor and/or materials

with an aggregate value greater than or equal to $20,000. Subsequent to submittal of this listing, Bidder shall not make any changes or substitutions to the listing.

SC-7.09 Add the following language at the end of paragraph 7.09 of the General Conditions:

Contractor shall refer to and comply with the stipulations set forth in Wisconsin Statutes 77.54 relating to a sales and use tax exemption for building materials that become part of a facility for a local unit of government. Tangible personal property that becomes a component of municipal treatment facilities qualifies for an exemption from Wisconsin sales and use tax. Refer to 2015 Wisconsin Act 126 that took effect on January 1, 2016.

ARTICLE 10 - ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03. Add the following language at the end of paragraph 10.03 of the General Conditions:

10.03.A.1 Engineer may furnish a Resident Project Representative (RPR), assistants, and other field staff to assist Engineer in observing the performance of the work by the Contractor. The duties, responsibilities, and limitations of authority of any such Resident Project Representative and assistants will be as provided in Exhibit A in these Supplementary Conditions.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

SC-13.01 Delete Paragraph 13.01.B.5.c in its entirety and insert the following in its place:

13.01.B.5.c. Construction Equipment and Machinery:

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor will be paid at a rate shown for such equipment in the Wisconsin Highway Maintenance Manual, Bureau of Highway Maintenance, Classified Equipment Rates, May 2017 edition. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs. Costs will include 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, shall cease to accrue when the use thereof is no longer necessary for the changed Work. Equipment or machinery with a value of less than $1,000 will be considered small tools.

ARTICLE 14 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

SC-14.02. Add the following paragraph:

14.02.G. In accordance with NR 166.19 Contractor shall provide proper facilities for access to, and inspection of, the Work by representatives of the Wisconsin Department of Natural Resources (WDNR). The Contractor shall allow the WDNR or any of its authorized representatives to have access to any books, documents, plans, reports, papers and other records that are pertinent to the Work for the purpose of making audits, inspections, examinations, excerpts, copies and transcriptions. The Contractor shall

ensure that all parties to sub-agreements will provide the WDNR access to the project, including sites, documents, and records.

ARTICLE 15 - PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.01. Amend the paragraph 15.01.D.1. of the General Conditions by striking out the words "Ten days" and inserting the words "Thirty days" in their place, and as so amended, paragraph 15.01.D.1. remains in effect.

SC-15.03. 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, shall 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 Article 15.

ARTICLE 16 - SUSPENSION OF WORK AND TERMINATION

SC-16.04. Amend the first sentence in paragraph 16.04.A of the General Conditions by striking out the words "30 days" in two places and inserting the words "60 days" in their place, and as so amended paragraph 16.04.A remains in effect.

ARTICLE 18 - MISCELLANEOUS

Add the following new paragraphs to Article 18 of the General Conditions:

SC-18.09. Lien Waivers

18.09.A Owner may require at any time during the Work, as well as at Substantial Completion of the Work, that Contractor furnish lien waivers for labor and materials used.

SC-18.10. Wage Rates

18.10.A.1. Contractors shall comply with the minimum wage rate for laborers and mechanics as determined by the Secretary of Labor in accordance with the provisions of the Davis-Bacon and Related Acts including 29 CRF Part 5.5a, and wage rates for construction as established by the State of Wisconsin Department of Workforce Development, Equal Rights Division – Labor Standards Bureau, pursuant to Wisconsin Statutes.

18.10.A.2. The Contractor shall comply with all applicable federal, state, and local rules and regulations regarding the posting, certification, and filing of Wage Rates paid to employees.

18.10.A.3. A prevailing Wage Rate determination for this project is on file with the Owner and/or included in the Project Manual.

SC-18.11. Equal Employment Opportunity Requirements

18.11.A. In connection with the performance of Work under this Contract, Contractor agrees not to discriminate against any employee or applicant for employment because of age, race, religion, color, handicap, sex, physical condition, developmental disability or national origin as defined in s. 51.01(5), Wisconsin Statutes. This provision shall include, but not be limited to, the following: employment, upgrading, demotion or

transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractor further agrees to take affirmative action to ensure equal employment opportunities for persons with disabilities. Contractor agrees to post in conspicuous places, available for employees and applicants for employment, notices setting forth the provisions of the nondiscrimination clause, a copy of which is included in the Project Manual.

SC-18.12. Disadvantaged Business Enterprises

18.12.A. The Contractor shall conform to the requirements for participation by disadvantaged business enterprises as described in Section 00830.

SC-18.13. Wisconsin Clean Water Fund Loan Program

18.13.A. This project is expected to be funded by a loan from the Wisconsin Clean Water Fund Loan Program. The Work in this project shall be subject to regulations contained in NR 162 of the Wisconsin Administrative Code and the applicable Wisconsin State Statutes.

SC-18.14. American Iron and Steel

18.14.A. Contractor shall comply with the requirements relating to the use of American Iron and Steel as described in Section 00840.

EXHIBIT A

A LISTING OF THE DUTIES, RESPONSIBILITIES AND LIMITATIONS OF AUTHORITY OF THE RESIDENT PROJECT REPRESENTATIVE

Engineer shall furnish a Resident Project Representative (RPR), assistants and other field staff to assist Engineer in observing performance of the Work of the Contractor.

Through more extensive on-site observations of the Work in progress and field checks of materials and equipment by the RPR and assistants, Engineer shall endeavor to provide further protection for Owner against defects and deficiencies in the Work; but, the furnishing of such services will not make Engineer responsible for or give Engineer control over construction means, methods, techniques, sequences or procedures or for safety precautions or programs, or responsibility for Contractor's failure to perform the Work in accordance with the Contract Documents.

The duties and responsibilities of the RPR are limited to those of Engineer in Engineer's agreement with the Owner and in the construction Contract Documents, and are further limited and described as follows:

A. GENERAL

RPR is Engineer's agent at the site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions. RPR's dealings in matters pertaining to the on-site work shall in general be with Engineer and Contractor keeping Owner advised as necessary. RPR's dealings with subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner with the knowledge of and under the direction of Engineer.

B. DUTIES AND RESPONSIBILITIES OF RPR

1. Schedules: Review the progress schedule, schedule of Shop Drawing submittals and schedule of values prepared by Contractor and consult with Engineer concerning acceptability.

2. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings.

3. Liaison:
   a) Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent and assist in understanding the intent of the Contract Documents; and assist Engineer in serving as Owner's liaison with Contractor.
   b) Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

4. Review of Work, Rejection of Defective Work, Inspections and Tests:
   a) Conduct on-site observations of the Work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
   b) Report to Engineer whenever RPR believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of Work that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

c) Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to Engineer.

5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed.

6. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report with RPR's recommendations to Engineer.

7. Records:
   a) Maintain at the job site orderly files for correspondence, reports of job conferences, Shop Drawings and samples, reproductions of original Contract Documents including Work Directive Changes, Addenda, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the Contract, Engineer's clarifications and interpretations of the Contract Documents, progress reports, and other Project related documents.
   b) Keep a diary or log book and send copies to Engineer.
   c) Record names, addresses and telephone numbers of all Contractors, subcontractors and major suppliers of materials and equipment.

8. Reports:
   a) Furnish Engineer periodic reports as required of progress of the Work.
   b) Consult with Engineer in advance of scheduled major tests, inspections or start of important phases of the Work.

9. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the schedule of values, Work completed and materials and equipment delivered at the site but not incorporated in the Work.

10. Completion:
    a) Before Engineer issues a Certificate of Substantial Completion, submit to Contractor a list of observed items requiring completion or correction.
    b) Conduct final inspection in the company of Engineer, Owner and Contractor and prepare a final list of items to be completed or corrected.
    c) Observe that items on final list have been completed or corrected and make recommendations to Engineer concerning acceptance.

C. LIMITATIONS OF AUTHORITY

Resident Project Representative:

1. Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by Engineer.

2. Shall not exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Shall not undertake any of the responsibilities of Contractor, subcontractors or Contractor's superintendent.

4. Shall not advise on, issue directions relative to or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.

5. Shall not advise on, issue directions regarding or assume control over safety precautions and programs in connection with the Work.

6. Shall not accept Shop Drawing or sample submittals from anyone other than Contractor.

7. Shall not authorize Owner to occupy the Project in whole or in part.

8. Shall not participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Engineer.

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EMPLOYEE RIGHTS
UNDER THE DAVIS-BACON ACT

FOR LABORERS AND MECHANICS EMPLOYED ON FEDERAL OR FEDERALLY ASSISTED CONSTRUCTION PROJECTS

THE UNITED STATES DEPARTMENT OF LABOR WAGE AND HOUR DIVISION

PREVAILING WAGES — You must be paid not less than the wage rate listed in the Davis-Bacon Wage Decision posted with this Notice for the work you perform.

OVERTIME — You must be paid not less than one and one-half times your basic rate of pay for all hours worked over 40 in a work week. There are few exceptions.

ENFORCEMENT — Contract payments can be withheld to ensure workers receive wages and overtime pay due, and liquidated damages may apply if overtime pay requirements are not met. Davis-Bacon contract clauses allow contract termination and debarment of contractors from future federal contracts for up to three years. A contractor who falsifies certified payroll records or induces wage kickbacks may be subject to civil or criminal prosecution, fines and/or imprisonment.

APPRENTICES — Apprentice rates apply only to apprentices properly registered under approved Federal or State apprenticeship programs.

PROPER PAY — If you do not receive proper pay, or require further information on the applicable wages, contact the Contracting Officer listed below:

or contact the U.S. Department of Labor's Wage and Hour Division.

For additional information:

1-866-4-USWAGE

(1-866-487-9243) TTY: 1-877-889-5627

U.S. Wage and Hour Division

WWW.WAGEHOUR.DOL.GOV

U.S. Department of Labor | Employment Standards Administration | Wage and Hour Division

WH 1321(Revised April 2009)

Appendix F

3. Contract and Subcontract provisions.

(a) The Recipient shall insure that the **subrecipient** (s) 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 public building or public work, or building or work 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 § 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 § 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.

Subrecipient s may obtain wage determinations from the U.S. Department of Labor's web site, www.wdol.gov.

(ii)(A) The **subrecipient** (s), 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 EPA 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 **subrecipient** (s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the **subrecipient** (s) to the State award official. The State award official will transmit the report, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the State award official or will notify the State award official 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 and the **subrecipient** (s) 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 questions, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. 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 in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The **subrecipient** (s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, 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 (Agency) 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 **subrecipient** , that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State

recipient or EPA. As to each payroll copy received, the **subrecipient** shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. 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 the 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 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm 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 **subrecipient** (s) for transmission to the State or EPA if requested by EPA , the State, the contractor, or the Wage and Hour Division of the Department of Labor 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 **subrecipient** (s).

(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 § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 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 State, EPA or the Department of Labor, 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 State 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 U.S. Department of Labor, 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 Executive Order 11246, as amended, and 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 by 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 requirements. All rulings and interpretations of the

Davis-Bacon and Related Acts 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 Department of Labor 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 **Subrecipient** (s), State, EPA, the U.S. Department of Labor, 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.

4. **Contract Provision for Contracts in Excess of $100,000.**

(a) Contract Work Hours and Safety Standards Act. The **subrecipient** shall insert the following clauses set forth in paragraphs (a)(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 Item 3, above or 29 CFF 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 (a)(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 (a)(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 (a)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The **subrecipient,** upon written request of the EPA Award Official or an authorized representative of the Department of Labor, 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 (a)(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 (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, 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 5.1, the **Subrecipient** 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 **Subrecipient** shall insert in any such contract a clause providing hat 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 (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

U.S. Department of Labor
Wage and Hour Division

PAYROLL

(For Contractor's Optional Use; See Instructions at www.dol.gov/whd/forms/wh347instr.htm)

Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

U.S. Wage and Hour Division

Rev. Dec. 2008

NAME OF CONTRACTOR ☐ OR SUBCONTRACTOR ☐ | ADDRESS | OMB No.: 1235-0008 Expires: 02/28/2018

PAYROLL NO. | FOR WEEK ENDING | PROJECT AND LOCATION | PROJECT OR CONTRACT NO.

(1) NAME AND INDIVIDUAL IDENTIFYING NUMBER (e.g., LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER) OF WORKER	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	OT. OR ST.	(4) DAY AND DATE / HOURS WORKED EACH DAY	(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS: FICA	WITH-HOLDING TAX			OTHER	TOTAL DEDUCTIONS	(9) NET WAGES PAID FOR WEEK
			O											
			S											
			O											
			S											
			O											
			S											
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While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) regulations at 29 C.F.R. § 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Public Burden Statement

We estimate that is will take an average of 55 minutes to complete this collection, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W. Washington, D.C. 20210

(over)

Date _____

I, _____ _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the
(Contractor or Subcontractor)

_____; that during the payroll period commencing on the
(Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____,

all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

_____ from the full
(Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948, 63 Stat. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

_____

_____

_____

_____

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

☐ – in addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

☐ – Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.

LABOR STANDARDS INTERVIEW

CONTRACT NUMBER	EMPLOYEE INFORMATION		
	LAST NAME	FIRST NAME	MI
NAME OF PRIME CONTRACTOR			
	STREET ADDRESS		
NAME OF EMPLOYER			
	CITY	STATE	ZIP CODE
SUPERVISOR'S NAME			
LAST NAME / FIRST NAME / MI	WORK CLASSIFICATION	WAGE RATE	

ACTION	CHECK BELOW YES	NO
Do you work over 8 hours per day?		
Do you work over 40 hours per week?		
Are you paid at least time and a half for overtime hours?		
Are you receiving any cash payments for fringe benefits required by the posted wage determination decision?		

WHAT DEDUCTIONS OTHER THAN TAXES AND SOCIAL SECURITY ARE MADE FROM YOUR PAY?

HOW MANY HOURS DID YOU WORK ON YOUR LAST WORK DAY BEFORE THIS INTERVIEW?	TOOLS YOU USE	
DATE OF LAST WORK DAY BEFORE INTERVIEW *(YYMMDD)*		
DATE YOU BEGAN WORK ON THIS PROJECT *(YYMMDD)*		

THE ABOVE IS CORRECT TO THE BEST OF MY KNOWLEDGE

EMPLOYEE'S SIGNATURE	DATE *(YYMMDD)*

INTERVIEWER	SIGNATURE	TYPED OR PRINTED NAME	DATE *(YYMMDD)*

INTERVIEWER'S COMMENTS

WORK EMPLOYEE WAS DOING WHEN INTERVIEWED	ACTION *(If explanation is needed, use comments section)*	YES	NO
	IS EMPLOYEE PROPERLY CLASSIFIED AND PAID?		
	ARE WAGE RATES AND POSTERS DISPLAYED?		

FOR USE BY PAYROLL CHECKER

IS ABOVE INFORMATION IN AGREEMENT WITH PAYROLL DATA?

☐ YES ☐ NO

COMMENTS

CHECKER

LAST NAME	FIRST NAME	MI	JOB TITLE

SIGNATURE	DATE *(YYMMDD)*

DAVIS-BACON REQUIREMENTS &
U.S. DEPARTMENT OF LABOR
WAGE RATE DETERMINATION

Contractor and all subcontractors are required to conform to the wage requirements prescribed by the federal Davis-Bacon and Related Acts, which require that all laborers and mechanics employed by contractors and subcontractors performing on projects funded in whole or in part with federal assistance to be paid wages not less than the locally prevailing rates, as determined by the U.S. Department of Labor. A copy of the federal wage rate determination is contained in this section. Included in the Contract Documents, by reference, are the following Davis-Bacon requirements:

1. Department of Labor wage determinations for this project
2. Wage rates must be applied to the Contractor and all subcontractors
3. Wage rate determinations and a Davis-Bacon poster (see Appendix E, this section) must be posted at all times by the Contractor and subcontractors at the work site in a prominent and accessible place
4. Davis-Bacon contract and subcontract provisions (see Appendix F, this section) are incorporated into the Contract Documents. Note that the term "**subrecipient**" used in Appendix F is the same as the Owner (City of South Milwaukee).
5. Contractors and subcontractors shall comply with Davis-Bacon reporting requirements, submitting certified payrolls to the Owner on a weekly basis (see Appendix G)
6. Owner may conduct onsite interviews to verify compliance (Appendix H).

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General Decision Number: WI180001 02/02/2018 WI1
Superseded General Decision Number: WI20170001
State: Wisconsin
Construction Type: Building
Counties: Milwaukee, Ozaukee, Washington and Waukesha
Counties in Wisconsin.

BUILDING CONSTRUCTION PROJECTS (Does not include residential construction consisting of single family homes and apartments up to and including 4 stories)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.35 for calendar year 2018 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, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually.
Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/05/2018
1	02/02/2018

ASBE0205-001 06/01/2001

	Rates	Fringes
Asbestos Removal worker/hazardous material handler Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials from mechanical systems, whether they contain asbestos or not	$ 17.90	4.45

BOIL0107-001 01/01/2017

	Rates	Fringes
BOILERMAKER		
Boilermaker	$ 35.65	29.89
Small Boiler Repair (under 25,000 lbs/hr)	$ 26.91	16.00

BRWI0005-001 06/01/2016

	Rates	Fringes
TERRAZZO WORKER	$ 32.39	19.65
TILE LAYER	$ 31.39	19.65

BRWI0008-001 06/01/2016

	Rates	Fringes
BRICKLAYER	$ 36.98	20.62

BRWI0008-003 06/01/2016

	Rates	Fringes
Marble Mason	$ 36.98	20.62

CARP0264-001 06/01/2016

	Rates	Fringes
Carpenter & Soft Floor Layer (Including Acoustical work and Drywall hanging; Excluding Batt Insulation)	$ 35.78	22.11

CARP2337-002 06/01/2016

	Rates	Fringes
MILLWRIGHT	$ 29.98	21.53

CARP2337-008 06/01/2016

	Rates	Fringes
PILEDRIVERMAN	$ 31.03	22.69

ELEC0494-001 06/01/2017

	Rates	Fringes
ELECTRICIAN	$ 37.51	24.42

ELEC0494-003 06/01/2015

	Rates	Fringes
Sound & Communications Installer	$ 16.47	14.84

Technician.....$ 26.00 17.70

Installation, testing, maintenance, operation and servicing of all sound, intercom, telephone interconnect, closed circuit TV systems, radio systems, background music systems, language laboratories, electronic carillion, antenna distribution systems, clock and program systems and low-voltage systems such as visual nurse call, audio/visual nurse call systems, doctors entrance register systems. Includes all wire and cable carrying audio, visual, data, light and radio frequency signals. Includes the installation of conduit, wiremold, or raceways in existing structures that have been occupied for six months or more where required for the protection of the wire or cable, but does not mean a complete conduit or raceway system. work covered does not include the installation of conduit, wiremold or any raceways in any new construction, or the installation of power supply outlets by means of which external electric power is supplied to any of the foregoing equipment or products

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* ELEV0015-001 01/01/2018

	Rates	Fringes
ELEVATOR MECHANIC	$ 47.94	32.645

FOOTNOTE:

PAID VACATION: 8% of regular basic for employees with more than 5 years of service, and 6% for 6 months to 5 years of service.

PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

ENGI0139-001 06/01/2017

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Power Equipment Operator		
Group 1	$ 44.11	21.15
Group 2	$ 43.61	21.15
Group 3	$ 43.11	21.15
Group 4	$ 42.42	21.15
Group 5	$ 39.94	21.15
Group 6	$ 34.79	21.15

HAZARDOUS WASTE PREMIUMS:
EPA Level "A" Protection: $3.00 per hour
EPA Level "B" Protection: $2.00 per hour
EPA Level "C" Protection: $1.00 per hour

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, Tower Cranes, Pedestal Tower Cranes and

Derricks with or w/o attachments with a lifting capacity of over 100 tons; or Cranes, Tower Cranes, Pedestal Tower Cranes and Derricks with boom, leads, and/or jib lengths measuring 176 feet or longer; Self-Erecting Tower Cranes over 4000 lbs lifting capacity; All Cranes with Boom Dollies; Boring Machines (directional); Master Mechanic. $0.50 additional per hour per 100 tons or 100 ft of boom over 200 ft or lifting capacity of crane over 200 tons to a maximum of 300 tons or 300 ft. Thereafter an increase of $0.01 per ft or ton, whichever is greater.

GROUP 2: Cranes, Tower Cranes, Pedestal Tower Cranes and Derricks with or without attachments with a lifting capacity of 100 tons or less; or Cranes, Tower Cranes Portable Tower Cranes, Pedestal Tower Cranes and Derricks with boom, leadsand/or jib lengths measuring 175 feet or less; Backhoes (excavators) 130,000 lbs and over; Caisson Rigs; Pile Drivers; Boring Machines (vertical or horizontal), Versi-Lift, Tri-Lift, Gantry 20,000 lbs & over.

GROUP 3: Backhoe (excavator) under 130,000 lbs;Self-erecting Tower Crane 4000 lbs & under lifting capacity;Traveling Crane (bridge type); Skid Rigs; Dredge Operator; Mechanic; Concrete Paver (over 27E); Concrete Spreader and Distributor; Forklift/ Telehandler (machinery- moving / steel erection); Hydro Blaster, 10,000 psi and over

GROUP 4: Material Hoists; Stack Hoists; Hydraulic Backhoe (tractor or truck mounted); Hydraulic Crane, 5 tons or under (tractor or truck mounted); Hoist (tuggers 5 tons & over); Hydro-Excavators/Daylighters; Concrete Pumps Rotec type Conveyors; Tractor/Bulldozer/End Loader (over 40 hp); Motor Patrol; Scraper Operator; Sideboom; Straddle Carrier; Welder; Bituminous Plant and Paver Operator; Roller over 5 tons; Rail Leveling Machine (Railroad); Tie Placer; Tie Extractor; Tie Tamper; Stone Leveler; Rotary Drill Operator and Blaster; Percussion Drill Operator; Air Track Drill and/or Hammers; Gantrys (under 20,000 lbs); Tencher (wheel type or chain type having 8 inch or larger bucket); Milling Machine; Off-Road Material Haulers.

GROUP 5: Backfiller; Concrete Auto Breaker (large); Concrete

Finishing Machines (road type); Rubber Tired Roller; Concrete Batch Hopper; Concrete Conveyor Systems; Grout Pumps; Concrete Mixers (14S or over); Screw Type Pumps and Gypsum Pumps; Tractor, Bulldozer, End Loader (under 40 hp); Trencher (chain type, bucket under 8 inch); Industrial Locomotives; Rollers under 5 tons; Stump Grinder/Chipper (Large); Timber Equipment; Firemen (pile drivers and derricks); Personnel Hoist, Telehandler over 8000 lbs; Robotic Tool Carrier with or without attachments

GROUP 6: Tampers - Compactors (riding type); Assistant Engineer; A-Frames and Winch Trucks; Concrete Auto Breaker; Hydrohammers (small); Brooms and Sweepers; Hoist (tuggers under 5 tons); Boats (Tug, Safety, Work Barges, Launch); Shouldering Machine Operator; Prestress Machines; Screed Operator; Stone Crushers and Screening Plants; Screed Operators (milling machine), Farm or Industrial Tractor Mounted Equipment; Post Hole Digger; Fireman (asphalt plants); Air Compressors over 400 CFM; Generators, over 150 KW; Augers (vertical and horizontal); Air, Electric, Hydraulic Jacks (slipform); Skid Steer Loaders (with or without attachments); Boiler Operators (temporary heat); Refrigeration Plant/Freeze Machines; Power Pack Vibratory/Ultra Sound Drivers and Extractors; Welding Machines; Heaters (mechanical); Pumps; Winches (small electric); Oiler and Greaser; Rotary Drill Tender; Conveyor; Forklifts/Telehandler 8000 lbs & under; Elevators: Automatic Hoists; Pumps (well points); Combination Small Equipment Operators

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IRON0008-005 06/01/2017

	Rates	Fringes
IRONWORKER	$ 33.19	26.97

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day & Christmas Day.

LABO0113-001 06/05/2017

	Rates	Fringes
LABORER		
(1) General Laborer (Including Plaster Tender)	$ 30.50	19.73

(2) Air & Electric
Equipment, Mortar Mixer,
Scaffold Builder, Erector,
and Swing Stage.....$ 30.61 19.73
(3) Jackhammer Operator,
Gunnite Machine Man.....$ 30.73 19.73
(4) Caisson Worker - Topman.$ 30.82 19.73
(5) Construction Specialist.$ 31.01 19.73
(6) Nozzleman.....$ 31.03 19.73
(7) Caisson Work.....$ 31.18 19.73
(8) Barco Tamper.....$ 31.76 19.73

LABO0113-010 06/05/2017

	Rates	Fringes
Asbestos Laborer		
Asbestos Abatement [Preparation, removal, and encapsulation of hazardous materials from non-mechanical systems]	$ 30.50	19.73

PAIN0781-001 06/01/2017

	Rates	Fringes
Painters:		
(1) Brush, Roller	$ 30.25	22.80
(2) Spray & Sandblast	$ 31.00	22.80
(3) Drywall Taper/Finisher	$ 30.60	22.80

PAIN1204-002 06/01/2017

	Rates	Fringes
GLAZIER	$ 36.09	20.10

PLAS0599-004 06/01/2017

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 33.95	21.93

PLAS0599-005 06/01/2017

	Rates	Fringes
PLASTERER	$ 32.65	22.55

PLUM0075-001 06/01/2016

	Rates	Fringes

PLUMBER (Including HVAC work)....$ 40.27 21.47

PLUM0601-001 06/04/2017

	Rates	Fringes
PIPEFITTER (Including HVAC work).....	$ 43.86	24.14

SFWI0183-001 01/01/2017

	Rates	Fringes
SPRINKLER FITTER.....	$ 40.76	21.72

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* SHEE0018-001 01/01/2018

	Rates	Fringes
Sheet Metal Worker (Including HVAC duct work and Technicians).....	$ 41.12	23.59

TEAM0662-003 06/04/2017

	Rates	Fringes
TRUCK DRIVER		
1 & 2 Axles.....	$ 27.40	20.48
3 or more Axles.....	$ 27.55	20.48

SUWI2002-002 01/23/2002

	Rates	Fringes
Asbestos Worker/Heat and Frost Insulator.....	$ 25.36	8.37
Laborers:		
Concrete Worker.....	$ 16.34	3.59
Landscape.....	$ 8.73	8.40
ROOFER.....	$ 18.01	3.28
Tile & Marble Finisher.....	$ 13.89	7.43

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 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) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which 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. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of 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. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write 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 by 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

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

General Decision Number: WI180008 01/05/2018 WI8
Superseded General Decision Number: WI20170008
State: Wisconsin
Construction Types: Heavy (Sewer and Water Line and Tunnel)
Counties: Wisconsin Statewide.

TUNNEL, SEWER & WATER LINE CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.35 for calendar year 2018 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, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually.
Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/05/2018

BRWI0001-002 06/01/2016
CRAWFORD, JACKSON, JUNEAU, LA CROSSE, MONROE, TREMPEALEAU, AND VERNON COUNTIES

	Rates	Fringes
BRICKLAYER	$ 31.84	20.95

BRWI0002-002 06/01/2016
ASHLAND, BAYFIELD, DOUGLAS, AND IRON COUNTIES

	Rates	Fringes
BRICKLAYER	$ 37.04	19.70

BRWI0002-005 06/01/2016
ADAMS, ASHLAND, BARRON, BROWN, BURNETT, CALUMET, CHIPPEWA,
CLARK, COLUMBIA, DODGE, DOOR, DUNN, FLORENCE, FOND DU LAC,
FOREST, GREEN LAKE, IRON, JEFFERSON, KEWAUNEE, LANGLADE,
LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE,
OCONTO, ONEIDA, OUTAGAMIE, POLK, PORTAGE, RUSK, ST CROIX, SAUK,
SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WALWORTH, WAUPACA, WAUSHARA,
WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 35.07	20.51

BRWI0003-002 06/01/2016

BROWN, DOOR, FLORENCE, KEWAUNEE, MARINETTE, AND OCONTO COUNTIES

	Rates	Fringes
BRICKLAYER	$ 32.22	20.57

BRWI0004-002 06/01/2016

KENOSHA, RACINE, AND WALWORTH COUNTIES

	Rates	Fringes
BRICKLAYER	$ 36.59	21.49

BRWI0006-002 06/01/2016

ADAMS, CLARK, FOREST, LANGLADE, LINCOLN, MARATHON, MENOMINEE, ONEIDA, PORTAGE, PRICE, TAYLOR, VILAS AND WOOD COUNTIES

	Rates	Fringes
BRICKLAYER	$ 33.04	19.75

BRWI0007-002 06/01/2016

GREEN, LAFAYETTE, AND ROCK COUNTIES

	Rates	Fringes
BRICKLAYER	$ 33.53	20.95

BRWI0008-002 06/01/2016

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
BRICKLAYER	$ 36.98	20.62

BRWI0009-001 06/01/2016

GREEN LAKE, MARQUETTE, OUTAGAMIE, SHAWANO, WAUPACA, WASHARA, AND WINNEBAGO COUNTIES

	Rates	Fringes
BRICKLAYER	$ 32.22	20.57

BRWI0011-002 06/01/2016

CALUMET, FOND DU LAC, MANITOWOC, AND SHEBOYGAN COUNTIES

	Rates	Fringes
BRICKLAYER	$ 32.22	20.57

BRWI0013-002 06/01/2016

DANE, GRANT, IOWA, AND RICHLAND COUNTIES

	Rates	Fringes
BRICKLAYER	$ 33.49	20.99

BRWI0019-002 06/01/2016

BARRON, BUFFALO, BURNETT, CHIPPEWA, DUNN, EAU CLAIRE, PEPIN, PIERCE, POLK, RUSK, ST. CROIX, SAWYER AND WASHBURN COUNTIES

	Rates	Fringes
BRICKLAYER	$ 31.98	20.81

BRWI0021-002 06/01/2015

DODGE AND JEFFERSON COUNTIES

	Rates	Fringes
BRICKLAYER	$ 33.58	16.65

BRWI0034-002 06/01/2015

COLUMBIA AND SAUK COUNTIES

	Rates	Fringes
BRICKLAYER	$ 32.86	17.22

CARP0087-001 05/01/2016

BURNETT (W. of Hwy 48), PIERCE (W. of Hwy 29), POLK (W. of Hwys 35, 48 & 65), AND ST. CROIX (W. of Hwy 65) COUNTIES

	Rates	Fringes
Carpenter & Piledrivermen	$ 36.85	18.39

CARP0252-002 06/01/2016

ADAMS, BARRON, BAYFIELD (Eastern 2/3), BROWN, BUFFALO, BURNETT (E. of Hwy 48), CALUMET, CHIPPEWA, CLARK, COLUMBIA, CRAWFORD, DANE, DODGE, DOOR, DUNN, EAU CLAIRE, FLORENCE (except area bordering Michigan State Line), FOND DU LAC, FOREST, GRANT, GREEN, GREEN LAKE, IOWA, IRON, JACKSON, JEFFERSON, JUNEAU, KEWAUNEE, LA CROSSE, LAFAYETTE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE (except N.E. corner), MARQUETTE, MENOMINEE, MONROE, OCONTO, ONEIDA, OUTAGAMIE, PEPIN, PIERCE (E. of Hwys 29 & 65), POLK (E. of Hwys 35, 48 & 65), PORTAGE, PRICE, RICHLAND, ROCK, RUSK, SAUK, SAWYER, SHAWANO, SHEBOYGAN, ST CROIX (E. of Hwy 65), TAYLOR, TREMPEALEAU, VERNON, VILAS, WALWORTH, WASHBURN, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
CARPENTER		
CARPENTER	$ 33.56	18.00
MILLWRIGHT	$ 35.08	18.35
PILEDRIVER	$ 34.12	18.00

CARP0252-010 06/01/2016

ASHLAND COUNTY

	Rates	Fringes
Carpenters		
Carpenter	$ 33.56	18.00
Millwright	$ 35.08	18.35
Pile Driver	$ 34.12	18.00

CARP0264-003 06/01/2016

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WAUKESHA, AND WASHINGTON COUNTIES

	Rates	Fringes
CARPENTER	$ 35.78	22.11

CARP0361-004 05/01/2016

BAYFIELD (West of Hwy 63) AND DOUGLAS COUNTIES

	Rates	Fringes
CARPENTER	$ 34.57	18.16

CARP2337-001 06/01/2016

ZONE A: MILWAUKEE, OZAUKEE, WAUKESHA AND WASHINGTON

ZONE B: KENOSHA & RACINE

	Rates	Fringes
PILEDRIVERMAN		
Zone A	$ 31.03	22.69
Zone B	$ 31.03	22.69

CARP2337-003 06/01/2016

	Rates	Fringes
MILLWRIGHT		
Zone A	$ 29.98	21.53
Zone B	$ 29.98	21.53

ZONE DEFINITIONS

ZONE A: MILWAUKEE, OZAUKEE, WAUKESHA AND WASHINGTON COUNTIES

ZONE B: KENOSHA & RACINE COUNTIES

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* ELEC0014-002 12/01/2017

ASHLAND, BARRON, BAYFIELD, BUFFALO, BURNETT, CHIPPEWA, CLARK (except Maryville, Colby, Unity, Sherman, Fremont, Lynn & Sherwood), CRAWFORD, DUNN, EAU CLAIRE, GRANT, IRON, JACKSON, LA CROSSE, MONROE, PEPIN, PIERCE, POLK, PRICE, RICHLAND, RUSK, ST CROIX, SAWYER, TAYLOR, TREMPEALEAU, VERNON, AND WASHBURN COUNTIES

	Rates	Fringes
Electricians:	$ 33.21	19.75

ELEC0127-002 06/01/2017

KENOSHA COUNTY

	Rates	Fringes
Electricians:	$ 38.50	30%+10.57

ELEC0158-002 06/05/2017

BROWN, DOOR, KEWAUNEE, MANITOWOC (except Schleswig), MARINETTE(Wausuakee and area South thereof), OCONTO, MENOMINEE (East of a ine 6 miles West of the West boundary of Oconto County), SHAWANO (Except Area North of Townships of Aniwa and Hutchins) COUNTIES

	Rates	Fringes
Electricians:	$ 31.48	19.18

ELEC0159-003 06/05/2017

COLUMBIA, DANE, DODGE (Area West of Hwy 26, except Chester and Emmet Townships), GREEN, LAKE (except Townships of Berlin, Seneca, and St. Marie), IOWA, MARQUETTE (except Townships of Neshkoka, Crystal Lake, Newton, and Springfield), and SAUK COUNTIES

	Rates	Fringes
Electricians:	$ 37.75	20.96

ELEC0219-004 06/01/2016

FLORENCE COUNTY (Townships of Aurora, Commonwealth, Fern, Florence and Homestead) AND MARINETTE COUNTY (Township of Niagara)

	Rates	Fringes
Electricians:		
Electrical contracts over $180,000	$ 32.38	18.63
Electrical contracts under $180,000	$ 30.18	18.42

ELEC0242-005 06/04/2017

DOUGLAS COUNTY

	Rates	Fringes
Electricians:	$ 35.90	25.64

ELEC0388-002 05/30/2016

ADAMS, CLARK (Colby, Freemont, Lynn, Mayville, Sherman, Sherwood, Unity), FOREST, JUNEAU, LANGLADE, LINCOLN, MARATHON, MARINETTE (Beecher, Dunbar, Goodman & Pembine), MENOMINEE (Area West of a line 6 miles West of the West boundary of Oconto County), ONEIDA, PORTAGE, SHAWANO (Aniwa and Hutchins), VILAS AND WOOD COUNTIES

	Rates	Fringes
Electricians:	$ 30.69	26.00% +10.05

ELEC0430-002 06/01/2017

RACINE COUNTY (Except Burlington Township)

	Rates	Fringes
Electricians:	$ 37.32	21.07

ELEC0494-005 06/01/2017

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Electricians:	$ 37.51	24.42

ELEC0494-006 06/01/2017

CALUMET (Township of New Holstein), DODGE (East of Hwy 26 including Chester Township), FOND DU LAC, MANITOWOC (Schleswig), and SHEBOYGAN COUNTIES

	Rates	Fringes
Electricians:	$ 32.06	21.88

ELEC0577-003 06/01/2017

CALUMET (except Township of New Holstein), GREEN LAKE (N. part including Townships of Berlin, St Marie, and Seneca), MARQUETTE (N. part including Townships of Crystal Lake, Neshkoro, Newton, and Springfield), OUTAGAMIE, WAUPACA, WAUSHARA, AND WINNEBAGO COUNTIES

	Rates	Fringes
Electricians:	$ 31.15	18.22

ELEC0890-003 06/01/2017

DODGE (Emmet Township only), GREEN, JEFFERSON, LAFAYETTE, RACINE (Burlington Township), ROCK AND WALWORTH COUNTIES

	Rates	Fringes
Electricians:.....	$ 33.25	19.34

ENGI0139-003 06/05/2017

REMAINING COUNTIES

	Rates	Fringes
Power Equipment Operator		
Group 1.....	$ 39.72	20.95
Group 2.....	$ 38.47	20.95
Group 3.....	$ 37.17	20.95
Group 4.....	$ 36.64	20.95
Group 5.....	$ 34.57	20.95
Group 6.....	$ 33.04	20.95

HAZARDOUS WASTE PREMIUMS:
EPA Level "A" Protection: $3.00 per hour
EPA Level "B" Protection: $2.00 per hour
EPA Level "C" Protection: $1.00 per hour

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of over 100 tons; Cranes, Tower Cranes, and Derricks with boom, leads and/or jib lengths 176 ft or longer.

GROUP 2: Backhoes (Excavators) weighing 130,00 lbs and over; Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of 100 tons or less; Cranes, Tower Cranes, and Derricks with boom, leads, and/or jib lengths 175 ft or less; Caisson Rigs; Pile Driver

GROUP 3: Backhoes (Excavators) weighing under 130,000 lbs; Travelling Crane (bridge type); Milling Machine; Concrete Paver over 27 E; Concrete Spreader and Distributor; Concrete Laser Screed; Concrete Grinder and Planing Machine; Slipform Curb and Gutter Machine; Boring Machine (Directional); Dredge Operator; Skid Rigs; over 46 meter Concrete Pump.

GROUP 4: Hydraulic Backhoe (tractor or truck mounted); Hydraulic Crane, 10 tons or less; Tractor, Bulldozer, or End Loader (over 40 hp); Motor Patrol; Scraper Operator; Bituminous Plant and Paver Operator; Screed-Milling Machine; Roller over 5 tons; Concrete pumps 46 meter and under; Grout Pumps; Rotec type machine; Hydro Blaster, 10,000 psi and over; Rotary Drill Operator; Percussion Drilling Machine; Air Track Drill with or without integral hammer; Blaster; Boring Machine (vertical or horizontal); Side Boom; Trencher, wheel type or chain type having 8 inch or larger bucket; Rail Leveling Machine (Railroad); Tie Placer; Tie Extractor; Tie Tamper; Stone Leveler; Straddle Carrier; Material Hoists; Stack Hoist; Man Hoists; Mechanic and Welder; Off Road Material Haulers.

GROUP 5: Tractor, Bulldozer, or Endloader (under 40 hp); Tampers -Compactors, riding type; Stump Chipper, large; Roller, Rubber Tire; Backfiller; Trencher, chain type (bucket under 8 inch); Concrete Auto Breaker, large; Concrete Finishing Machine (road type); Concrete Batch Hopper; Concrete Conveyor Systems; Concrete Mixers, 14S or over; Pumps, Screw Type and Gypsum); Hydrohammers, small; Brooms and Sweeeprs; Lift Slab Machine; Roller under 5 tons; Industrial Locomotives; Fireman (Pile Drivers and Derricks); Pumps (well points); Hoists, automatic; A-Frames and Winch Trucks; Hoists (tuggers); Boats (Tug, Safety, Work Barges and Launches); Assistant Engineer

GROUP 6: Shouldering Machine Operator; Farm or Industrial Tractor mounted equipment; Post Hole Digger; Auger (vertical and horizontal); Skid Steer Loader with or without attachments; Robotic Tool Carrier with or without attachments; Power Pack Vibratory/Ultra Sound Driver and Extractor; Fireman (Asphalt Plants); Screed Operator; Stone Crushers and Screening Plants; Air, Electric, Hydraulic Jacks (Slip Form); Prestress Machines; Air Compressor, 400 CFM or over; Refrigeration Plant/Freese Machine; Boiler Operators (temporary heat); Forklifts; Welding Machines; Generators; Pumps over 3"; Heaters, Mechanical; Combination small equipment operator; Winches, small electric; Oiler; Greaser; Rotary Drill Tender; Conveyor; Elevator Operator

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ENGI0139-007 06/05/2017

DODGE, FOND DU LAC, JEFFERSON, KENOSHA, MILWAUKEE, OZAUKEE,
RACINE, SHEBOYGAN, WALWORTH, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Power Equipment Operator		
Group 1	$ 39.19	21.30
Group 2	$ 38.41	21.30
Group 3	$ 37.46	21.30
Group 4	$ 36.41	21.30
Group 5	$ 35.01	21.30

HAZARDOUS WASTE PREMIUMS:
EPA Level "A" Protection: $3.00 per hour
EPA Level "B" Protection: $2.00 per hour
EPA Level "C" Protection: $1.00 per hour

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, Tower Cranes, and Derricks with or without attachments, with a lifting capacity of over 100 tons; or Cranes, Tower Cranes, and Derricks with boom, leads, and/or jib lengths measuring 176 feet or longer; Backhoes (Excavators) 130,000 lbs and over; Caisson Rigs and Pile

Drivers

GROUP 2: Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of 100 tons or under; or Cranes, Tower Cranes, and Derricks with boom, lead, and\or jib lengths measuring 175 feet or under; Backhoes (Excavators) under 130,000 lbs; Skid Rigs; Dredge Operator: Traveling Crane (Bridge type); Concrete Paver over 27 E; Concrete Spreader and Distributor; Concrete Pumps and Boring Machines (directional)

GROUP 3: Material Hoists; Stack Hoists; Tractor or Truck mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane, 5 tons or under; Manhoist; Tractor over 40 hp; Bulldozer over 40 hp; Endloader over 40 hp; Forklift, 25 ft and over; Motor Patrol; Scraper Operator; Sideboom; Straddle Carrier; Mechanic and Welder; Bituminous Plant and Paver Operator; Roller over 5 tons; Percussion Drill Operator; Rotary Drill Operator; Blaster; Air Track Drill; Trencher (wheel type or chain type having over 8 inch bucket); Elevator; Milling Machine and Boring Machine (horizontal or vertical); Backhoe Mounted Compactor

GROUP 4: Backfiller; Concrete Auto Breaker (large); Concrete Finishing Machine (road type); Roller, Rubber Tire; Concrete Batch Hopper; Concrete Conveyor System; Concrete Mixers (14S or over); Screw type Pumps and Gypsum Pumps; Grout Pumps; Tractor, Bulldozer, End Loader, under 40 hp; Pumps (well points); Trencher (chain type 8 inch or smaller bucket; Industrial Locomotives; Roller under 5 tons; Fireman (Piledrivers and Derricks); Robotic Tool Carrier with or without attachments.

GROUP 5: Hoists (Automatic); Forklift, 12 ft to 25 ft; Tamper-Compactors, riding type; A-Frame andWinch Trucks; Concrete Auto Breaker; Hydrohammer, small; Brooms and Sweepers; Hoist (Tuggers); Stump Chipper, large; Boats (Tug, Safety, Work Barges and Launch); Shouldering Machine Operator; Screed Operator; Farm or Industrial Tractor; Post Hole Digger; Stone Crushers and Screening Plants; Firemen (Asphalt Plants); Air Compressor (400 CFM or over); Augers (vertical and horizontal); Generators, 150 KW and over;

Air, Electric Hydraulic Jacks (Slipform); Prestress Machines; Skid Steer Loader with or without attachments; Boiler operators (temporary heat); Forklift, 12 ft and under; Screed Operator Milling Machine; Refrigeration Plant/Freeze Machine; Power Pack Vibratory/Ultra Sound Driver and Extractor; Generators under 150 KW; Combination small equipment operator; Compressors under 400 CFM; Welding Machines; Heaters, Mechanical; Pumps; Winches, Small Electric; Oiler and Greaser; Conveyor; High pressure utility locating machine (daylighting machine).

IRON0008-002 06/01/2017

BROWN, CALUMET, DOOR, FOND DU LAC, KEWAUNEE, MANITOWOC, MARINETTE, OCONTO, OUTAGAMI, SHAWANO, SHEBOYGAN, AND WINNEBAGO COUNTIES:

	Rates	Fringes
IRONWORKER	$ 31.24	26.97

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day & Christmas Day.

IRON0008-003 06/01/2017

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WALWORTH (N.E. 2/3), WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
IRONWORKER	$ 33.19	26.97

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day & Christmas Day.

IRON0383-001 06/01/2017

ADAMS, COLUMBIA, CRAWFORD, DANE, DODGE, FLORENCE, FOREST, GRANT, GREENE, (Excluding S.E. tip), GREEN LAKE, IOWA, JEFFERSON, JUNEAU, LA CROSSE, LAFAYETTE, LANGLADE, MARATHON, MARQUETTE, MENOMINEE, MONROE, PORTAGE, RICHLAND, ROCK (Northern area, vicinity of Edgerton and Milton), SAUK, VERNON, WAUPACA, WAUSHARA, AND WOOD COUNTIES

	Rates	Fringes
IRONWORKER	$ 34.50	23.82

IRON0498-005 06/01/2016

GREEN (S.E. 1/3), ROCK (South of Edgerton and Milton), and WALWORTH (S.W. 1/3) COUNTIES:

	Rates	Fringes
IRONWORKER	$ 36.29	30.77

IRON0512-008 05/01/2017

BARRON, BUFFALO, CHIPPEWA, CLARK, DUNN, EAU CLAIRE, JACKSON,
PEPIN, PIERCE, POLK, RUSK, ST CROIX, TAYLOR, AND TREMPEALEAU COUNTIES

	Rates	Fringes
IRONWORKER	$ 36.50	26.45

IRON0512-021 05/01/2017

ASHLAND, BAYFIELD, BURNETT, DOUGLAS, IRON, LINCOLN, ONEIDA,
PRICE, SAWYER, VILAS AND WASHBURN COUNTIES

	Rates	Fringes
IRONWORKER	$ 32.04	26.45

LABO0113-004 06/05/2017

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Laborers: (Open Cut)		
Group 1	$ 14.78	20.23
Group 2	$ 17.05	20.23
Group 3	$ 20.59	20.23
Group 4	$ 29.96	20.23
Group 5	$ 30.10	20.23
Group 6	$ 30.16	20.23
Group 7	$ 32.37	20.23
Group 8	$ 35.19	20.23
Group 9	$ 35.83	20.23

LABORERS CLASSIFICATIONS [OPEN CUT]
GROUP 1: Yard Laborer
GROUP 2: Landscaper
GROUP 3: Flag Person
GROUP 4: Paving Laborer
GROUP 5: General Laborer on Surface; Top Man
GROUP 6: Mud Mixer
GROUP 7: Mucker; Form Stripper; Bottom Digger and Misc;
Bottom Man and Welder on Surface
GROUP 8: Concrete Manhole Builder; Caisson Worker; Miner;
Pipe Layer; Rock Driller and Joint Man; Timber Man and
Concrete Brusher; Bracer in Trench Behind Machine & Tight
Sheeting; Concrete Formsetter and Shoveler; Jackhammer
Operator
GROUP 9: Blaster

LABO0113-005 06/05/2017

SEWER, TUNNEL & UNDERGROUND

KENOSHA AND RACINE COUNTIES

	Rates	Fringes
Laborers:		
Group 1	$ 21.45	20.23
Group 2	$ 27.38	20.23
Group 3	$ 29.94	20.23
Group 4	$ 31.71	20.23

TUNNEL WORK UNDER COMPRESSED AIR: 0-15 lbs add $1.00, 15-30 lbs add $2.00, over 30 lbs add $3.00

LABORERS CLASSIFICATIONS

GROUP 1: Flagperson

GROUP 2: Top Man, General Laborer, Wellpoint Installation, Wire Mesh and Reinforcement, Concrete Worker, Form Stripper, Strike-off Work

GROUP 3: Machine and Equipment Operator, Sheeting, Form Setting, Patch Finisher, Bottom Man, Joint Sawer, Gunnite Man, Manhole Builder, Welder-Torchman, Blaster, Caulker, Bracer, Bull Float, Conduit Worker, Mucker and Car Pusher, Raker and Luteman, Hydraulic Jacking of Shields, Shield Drivers, Mining Machine, Lock Tenders, Mucking Machine Operator, Motor Men & Gauge Tenders and operation of incidental Mechanical Equipment and all Power Driven Tools

GROUP 4: Pipelayer, Miner and Laser Operator

LABO0113-008 06/01/2017

MILWAUKEE, OZAUKEE, WASHINGTON & WAUKESHA COUNTIES

	Rates	Fringes
Laborers: (Tunnel-Free Air)		
Group 1	$ 20.59	20.23
Group 2	$ 30.10	20.23
Group 3	$ 30.16	20.23
Group 4	$ 32.37	20.23
Group 5	$ 32.51	20.23
Group 6	$ 35.19	20.23
Group 7	$ 35.83	20.23

LABORERS CLASSIFICATIONS [TUNNEL - FREE AIR]:
GROUP 1: Flagperson
GROUP 2: General Laborer on surface; Tower Man
GROUP 3: Saw Man; Top Man
GROUP 4: Form Stripper; Car Pusher
GROUP 5: Mucker; Dinkey; Welder (rate on surface)
GROUP 6: Concrete Manhole Builder; Mucking Machine; Miner; Mining Machine; Welder; Rock Driller; Concrete Buster; Jack Hammer Operator; Caisson Worker; Pipelayer and Joint Man; Bracerman
GROUP 7: Blaster

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* LABO0113-009 06/01/2017
MILWAUKEE, OZAUKEE, WASHINGTON & WAUKESHA COUNTIES

	Rates	Fringes
Laborers: (Tunnel -		
*COMPRESSED AIR 0 - 15 lbs.)		
Group 1	$ 20.59	20.23
Group 2	$ 30.10	20.23
Group 3	$ 32.91	20.23
Group 4	$ 33.71	20.23
Group 5	$ 33.83	20.23
Group 6	$ 36.53	20.23
Group 7	$ 37.15	20.23

LABORERS CLASSIFICATIONS [TUNNEL - COMPRESSED AIR]:
*Compressed Air 15 - 30 lbs add $2.00 to all classifications
*Compressed Air over 30 lbs add $3.00 to all classifcations

GROUP 1: Flagperson
GROUP 2: General Laborer on surface
GROUP 3: Lock Tender on surface
GROUP 4: Form Stripper; Car Pusher
GROUP 5: Mucker; Dinkey
GROUP 6: Mucking Machine; Miner; Mining Machine; Welder & Rock Driller; Lock Tender in tunnel; Concrete Buster; Jack Hammer Operator; Caisson Worker; Pielayer and Joint Man; Bracerman; Nozzle Man on Gunite; Timber Man; Concrete Brusher
GROUP 7: Blaster

NOTE: Hazardous & Toxic Waste Removal: add $0.15 per hour.

LABO0140-005 06/05/2017

ADAMS, ASHLAND, BARRON, BROWN, BUFFALO, CALUMET, CHIPPEWA,
CLARK, COLUMBIA, CRAWFORD, DODGE, DOOR, DUNN, EAU CLAIRE,
FLORENCE,FOND DU LAC, FOREST, GRANT, GREEN, GREEN LAKE, IOWA,
JACKSON, JEFFERSON, JUNEAU, LACROSSE, LAFAYETTE, LANGLADE,
LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE,
MONROE, OCONTO, ONEIDA, OUTAGAMIE, PEPIN, PIERCE, POLK,
PORTAGE, PRICE, RICHLAND, ROCK, RUSK, ST CROIX, SAUK, SAWYER,
SHAWANO, SHEBOYGAN, TAYLOR, TREMMPEALEAU, VERNON, VILAS,
WALWWORTH, WASHBURN, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
LABORER (SEWER & WATER)		
Group 1	$ 26.41	16.79
Group 2	$ 28.26	16.79
Group 3	$ 28.46	16.79
Group 4	$ 29.21	16.79

FOR ALL TUNNEL WORK UNDER COMPRESSED AIR: 0-15 lbs add $1.00, 15-30 lbs add $2.00, over 30 lbs add $3.00

LABORER CLASSIFICATIONS:
GROUP 1: Flagperson
GROUP 2: General Laborer, Wellpoint Installation; Form Stripper; Strike Off worker
GROUP 3: Sheeting Formsetting; Patch Finisher; Bottom Man; Joint Sawer; Gunnite Man; Manhole Builder; Welder; Torchman; Blaster; Caulker Bracer; Bull Float; Mucker and Car Pusher; Raker and Luteman; Hydraulic jacking of shields, Shield Drivers; Mining Machine; Lock Tenders; Mucking Machine Operators; Motor Men and Gauge Tenders; Power Tool Operators
GROUP 4: Pipelayer, Miner, and Laser Operator

LABO0464-002 06/05/2017

DANE AND DOUGLAS COUNTIES

	Rates	Fringes
LABORER		
Group 1	$ 26.31	16.79
Group 2	$ 28.51	16.79
Group 3	$ 28.71	16.79
Group 4	$ 29.46	16.79

FOR ALL TUNNEL WORK UNDER COMPRESSED AIR: 0 - 15 lbs add
$1.00, 15- 30 lbs add $2.00, over 30 lbs add $3.00

LABORERS CLASSIFICATIONS:
GROUP 1: Flagperson
GROUP 2: General Laborer; Wellpoint Installation; Concrete Worker; Form Stripper; Strike Off worker
GROUP 3: Sheeting Formsetting; Patch Finisher; Bottom Man; Joint Sawer; Gunnite Man; Manhole Builder; Welder; Torchman; Blaster; Caulker Bracer; Bull Float; Mucker and Car Pusher; Raker and Luteman; Hydraulic jacking of shields, Shield Dirvers; Mining Machine; Lock Tenders; Mucking Machine Operators; Motor Men and Gauge Tenders; Power Tool Operators
GROUP 4: Pipelayer, Miner, and Laser Operator

LABO1091-010 06/05/2017
BAYFIELD, BURNETT, IRON, SAWYER, AND WASHBURN COUNTIES

	Rates	Fringes
Laborers: (SEWER & WATER)		
Group 1	$ 26.10	16.75
Group 2	$ 28.16	16.75
Group 3	$ 28.36	16.75
Group 4	$ 29.11	16.75

FOR ALL TUNNEL WORK UNDER COMPRESSED AIR:
0 - 15 lbs add $1.00, 15-30 lbs add $2.00, over 30 lbs add $3.00

LABORERS CLASSIFICATIONS:
GROUP 1: Flagperson
GROUP 2: Laborers, Wellpoint Installation; Form Stripper; Strike Off worker
GROUP 3: Sheeting Formsetting; Patch Finisher; Bottom Man; Joint Sawer; Gunnite Man; Manhole Builder; Welder; Torchman; Blaster; Caulker Bracer; Bull Float; Mucker and Car Pusher; Raker and Luteman; Hydraulic jacking of shields, Shield Dirvers; Mining Machine; Lock Tenders; Mucking Machine Operators; Motor Men and Gauge Tenders; Power Tool Operators
GROUP 4: Pipelayer, Miner, and Laser Operator

PLAS0599-010 06/01/2017

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
Area 1	$ 39.46	17.17
Area 2 (BAC)	$ 35.07	19.75
Area 3	$ 35.61	19.40
Area 4	$ 34.70	20.51
Area 5	$ 36.27	18.73
Area 6	$ 32.02	22.99

AREA DESCRIPTIONS
AREA 1: BAYFIELD, DOUGLAS, PRICE, SAWYER, AND WASHBURN COUNTIES
AREA 2: ADAMS, ASHLAND, BARRON, BROWN, BURNETT, CALUMET, CHIPPEWA, CLARK, COLUMBIA, DODGE, DOOR, DUNN, FLORENCE, FOND DU LAC, FOREST, GREEN LAKE, IRON, JEFFERSON, KEWAUNEE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE, OCONTO, ONEIDA, OUTAGAMIE, POLK, PORTAGE, RUSK, ST CROIX, SAUK, SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WALWORTH, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES
AREA 3: BUFFALO, CRAWFORD, EAU CLAIRE, JACKSON, JUNEAU, LA CROSSE MONROE, PEPIN, PIERCE, RICHLAND, TREMPEALEAU, AND VERNON COUNTIES
AREA 4: MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES
AREA 5: DANE, GRANT, GREEN, IOWA, LAFAYETTE, AND ROCK COUNTIES
AREA 6: KENOSHA AND RACINE COUNTIES

TEAM0039-001 06/01/2017

	Rates	Fringes
TRUCK DRIVER		
1 & 2 Axles	$ 27.40	20.48
3 or more Axles; Euclids Dumptor & Articulated, Truck Mechanic	$ 27.55	20.48
WELL DRILLER	$ 16.52	3.70

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 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) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular

rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which 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. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers
Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of 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. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers
Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:
* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write 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 by 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

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

NOTICE OF EQUAL OPPORTUNITY

In connection with the performance of work on this project under a contract involving funds of the State of Wisconsin Department of Natural Resources, the contractor has agreed not to discriminate against any employee or applicant for employment because of age, race, religion, color, handicap, sex, physical condition, national origin or developmental disability as defined in S.51.01 (5), Wisconsin Statutes. The contractor has also agreed to take affirmative action to ensure equal employment opportunities. These provisions apply to, but are not limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

_____

Contractor's Signature

_____

Date

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State of Wisconsin
Department of Natural Resources
Bureau of Community Financial Assistance
101 S. Webster St., PO Box 7921
Madison WI 53707-7921
Phone No. (608) 266-7555 FAX (608) 267-0496
Website: dnr.wi.gov/Aid/EIF.html

Environmental Improvement Fund (EIF)
DBE Contacts Worksheet

Form 8700-294A (R 03/17)

NOTE: This form is authorized by chs. NR 162 and NR 166, Wis. Adm. Code. The information requested on this form is necessary for the review of solicitation of Disadvantaged Business Enterprises (DBEs). This form is intended to be a tool to assist those seeking funding from the EIF (Clean Water Fund Program or Safe Drinking Water Loan Program) to meet the DBE requirements of EIF programs. Submitting this form to the Department is optional. Applicants may submit the form as the required documentation of solicitation efforts or provide the information in some other format. Personally identifiable information provided on this form will only be used in determining whether or not DBE requirements are met. Failure to complete or submit this form has no impact on the applicant. For complete information regarding DBE requirements, see the Contract Packet for DBE Compliance on DNR's website at http://dnr.wi.gov/Aid/documents/EIF/Guide/DBE.html.

Contact DBEs on a Unified Certification Program (UCP) List to solicit bids from DBE firms (e.g., firms registered in the WisDOT UCP, http://wisconsindot.gov/pages/doing-bus/civil-rights/dbe/certified-firms.aspx). The individual that makes the contacts should document all contacts. Contact at least 2 minority business enterprises (MBEs) and 2 women's business enterprises (WBEs); additional contacts may be to any type of DBE. Only contacts made to DBEs on DOT's UCP list can be considered in determining whether a good faith effort was made to solicit DBEs.

Project Information

Name of Municipality	EIF Project Number
Name of Prime Contractor	Information Prepared By (Name and Phone or E-Mail Address)

Contacts

Information Needed For Review	Contact 1	Contact 2	Contact 3
a. Name of Firm Contacted			
b. Contact's Phone Number or E-Mail			
c. Firm Type	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE
d. On DOT UCP list?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
e. Date Contacted			
f. Result of contact			
g. Bid received?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
h. If bid received and rejected, why rejected?			
i. Utilizing this firm? (If yes, more on p. 4)*	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No

Information Needed For Review	Contact 4	Contact 5	Contact 6
a. Name of Firm Contacted			
b. Contact's Phone Number or E-Mail			
c. Firm Type	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE
d. On DOT UCP list?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
e. Date Contacted			
f. Result of contact			
g. Bid received?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
h. If bid received and rejected, why rejected?			
i. Utilizing this firm? (If yes, more on p. 4)*	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No

Information Needed For Review	Contact 7	Contact 8	Contact 9
a. Name of Firm Contacted			
b. Contact's Phone Number or E-Mail			
c. Firm Type	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE
d. On DOT UCP list?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
e. Date Contacted			
f. Result of contact			
g. Bid received?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
h. If bid received and rejected, why rejected?			
i. Utilizing this firm? (If yes, more on p. 4)*	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No

Information Needed For Review	Contact 10	Contact 11	Contact 12
a. Name of Firm Contacted			
b. Contact's Phone Number or E-Mail			
c. Firm Type	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE
d. On DOT UCP list?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
e. Date Contacted			
f. Result of contact			
g. Bid received?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
h. If bid received and rejected, why rejected?			
i. Utilizing this firm? (If yes, more on p. 4)*	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No

Information Needed For Review	Contact 13	Contact 14	Contact 15
a. Name of Firm Contacted			
b. Contact's Phone Number or E-Mail			
c. Firm Type	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE
d. On DOT UCP list?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
e. Date Contacted			
f. Result of contact			
g. Bid received?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
h. If bid received and rejected, why rejected?			
i. Utilizing this firm? (If yes, more on p. 4)*	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No

Information Needed For Review	Contact 16	Contact 17	Contact 18
a. Name of Firm Contacted			
b. Contact's Phone Number or E-Mail			
c. Firm Type	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE	◯ MBE ◯ WBE ◯ Other DBE
d. On DOT UCP list?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
e. Date Contacted			
f. Result of contact			
g. Bid received?	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No
h. If bid received and rejected, why rejected?			
i. Utilizing this firm? (If yes, more on p. 4)*	◯ Yes ◯ No	◯ Yes ◯ No	◯ Yes ◯ No

Information on Utilized Firms

Business Name	Street Address	City, State, Zip	Type of Product or Service	Subcontract Amount

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractors[2] and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

Prime Contractor Name		Project Name
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.		Email Address
Issuing/Funding Entity:		

I have identified potential DBE certified subcontractors	___ YES	___ NO
If yes, please complete the table below. If no, please explain:		

Subcontractor Name/ Company Name	**Company Address/ Phone/ Email**	**Est. Dollar Amt**	**Currently DBE Certified?**

Continue on back if needed

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

United States Environmental Protection Agency

OMB Control No:
Approved:
Approval Expires:

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	**Date**

The public reporting and recordkeeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

WISCONSIN DNR
ENVIRONMENTAL LOAN PROGRAM
DISADVANTAGED BUSINESS ENTERPRISE (DBE) REQUIREMENTS

NOTE: Where the terms "municipalities" or "recipient(s)" are used, they have the same meaning as "Owner" (City of Watertown). This project is **not** designated a federal equivalency project, so requirements specific to federal equivalency projects do not apply.

All municipalities applying for funds from the Environmental Improvement Fund (EIF) **must make good faith efforts** to solicit disadvantaged business enterprises (DBEs) in their construction projects. When procuring construction work, equipment, raw materials or supplies for a project, a municipality must comply with the DBE solicitation requirements whenever the procurement must be bid under the state procurement laws. The EIF includes the Clean Water Fund Loan Program (CWFLP) and the Safe Drinking Water Loan Program (SDWLP); DBEs include, but are not limited to, minority business enterprises (MBEs) and women business enterprises (WBEs). **Prime contractors and subcontractors** participating in an EIF-funded project **must also make good faith efforts** whenever they subcontract for construction work, equipment, raw materials or supplies.

For any **bids advertised on or after January 1, 2011** for an EIF-funded project, municipalities and contractors must meet the new DBE requirements, including the solicitation requirements below. Prime contractors and subcontractors must continue to use the solicitation methods described below under "Three Options to Meet Solicitation Requirements" when hiring any subcontractors for EIF projects, even if utilization goals have already been met.

Three Options to Meet Solicitation Requirements
Municipalities, when hiring prime contractors; prime contractors, when hiring subcontractors; and subcontractors when hiring other subcontractors, must do ***at least one*** of the following in order to comply with DBE solicitation requirements:

1. Include language **in bid advertisements** that encourages DBEs to submit bid proposals. If contracts are advertised separately, each advertisement should include the DBE language.

MUNICIPALITIES: To make a good faith effort when hiring prime contractors, the municipality can add a simple statement to its advertisements for prime contractors such as "We encourage DBEs, including MBEs and WBEs, to submit bid proposals." The advertisements must appear at least in the official newspaper of public record for the municipality. ***The municipality must then submit a copy of the advertisement to the DNR along with other bid documents.***

PRIME CONTRACTORS AND SUBCONTRACTORS: To make a good faith effort when subcontracting, a contractor can advertise for subcontractors with an ad that includes a simple statement like "DBEs, including MBEs and WBEs, are encouraged to submit proposals." If just one advertisement is published for all areas of work that may be subcontracted, it should indicate those types of work that could be subcontracted. The advertisement(s) must appear in an industry trade publication and/or the official newspaper of public record for the municipality. ***The prime contractor should supply a copy of the advertisement to the consulting engineer or the municipality so they can submit it to the DNR along with other bid documents.***

2. Contact DBEs **on a Unified Certification Program (UCP) List** to solicit bids from these firms (e.g., firms registered in the WisDOT UCP, http://wisconsindot.gov/Pages/doing-bus/civil-rights/dbe/certified-firms.aspx). This good faith effort option is available for municipalities, prime contractors and subcontractors to comply with

the DBE requirements. The individual that makes the contacts should document all the contacts. A contacts worksheet (WDNR Form 8700-294A) is attached and may be used for documentation of contacts.

3. Utilize DBEs* registered with the UCP** (e.g., WisDOT UCP, http://wisconsindot.gov/Pages/doing-bus/civil-rights/dbe/certified-firms.aspx). Municipalities must require prime contractors to complete and submit with bids EPA Form 6100-4, DBE Subcontractor Utilization Form, for any DBE subcontractors they intend to use on the contract. ***Municipalities must then submit those forms to DNR along with other bidding documents prior to loan closing.

THE SIX GOOD FAITH EFFORTS

All CWFP and SDWLP financial assistance recipients must comply with the Six Good Faith Effort requirements.

What is the purpose of the Six Good Faith Efforts?

The Six Good Faith Efforts are required by EPA for financial assistance agreement recipients to ensure that all disadvantaged business enterprises (DBEs) have the opportunity to compete for procurements funded by EPA financial assistance dollars.

What are the Six Good Faith Efforts?

1) Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Tribal, Local and Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.

2) 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 solicitations for bids or proposals for a minimum of 30 calendar days before the bid proposal closing date.

3) Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Tribal and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

4) Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

5) Use the services and assistance of the Small Business Administration (SBA) and the Minority Business Development Agency of the U.S. Department of Commerce.

6) If the prime contractor awards subcontracts, require the prime contractor to take the steps in paragraphs (1) through (5) of this section.

What new forms are required?

~~**1)** EPA Form 6100-2 – DBE Program Subcontractor Participation Form. **For projects designated as federal equivalency only.** This form gives a DBE subcontractor the opportunity to describe the work the DBE subcontractor received from the prime contractor, how much the DBE subcontractor was paid and any other concerns the DBE subcontractor might have.~~

~~The **prime contractor must** provide ***EPA Form 6100-2 DBE Program Subcontractor Participation Form*** to all of its Disadvantaged Business Enterprise subcontractors. Disadvantaged Business Enterprise **subcontractors may** send completed Form 6100-2 directly to the Region 5 DBE Coordinator listed below.~~

~~Adrianne M. Callahan, Region 5 MBE/WBE Coordinator~~
~~USEPA, Acquisition and Assistance Branch~~
~~77 West Jackson Boulevard (MC-10J)~~
~~Chicago, IL 60604~~

~~**2)** EPA Form 6100-3 – DBE Program Subcontractor Performance Form. **For projects designated as federal equivalency only.** This form, at the time of the bid, captures an intended subcontractor's description of work to be performed for the prime contractor and the price of the work submitted to the prime.~~

3) EPA Form 6100-4 – DBE Program Subcontractor Utilization Form. **ALL CWFP and SDWLP financial assistance recipients that utilize one or more DBEs in their project must submit Form 6100-4.** This form captures the prime's intended use of an identified DBE subcontractor, and the estimated dollar amount of the subcontract.

Form	Requirements	Provided by:	Completed by:	Submitted To:
~~EPA Form 6100-2~~	~~Recipients required to have prime contractors provide form to Subcontractors~~	~~Prime Contractors~~	~~DBE Subcontractors, if they choose to submit the form~~	~~EPA DBE Coordinator~~
~~EPA Form 6100-3~~	~~Recipients required to have prime contractors provide form to Subcontractors~~	~~Prime Contractors~~	~~DBE Subcontractors~~	~~Recipients as part of a bid or proposal package~~
EPA Form 6100-4	Recipients required to have prime contractors complete the form	Recipients	Prime Contractors	Recipients as part of a bid or proposal package

Note: EPA Form 6100-4 is included in this section and is available on the WDNR website at http://dnr.wi.gov/aid/documents/eif/forms/forms.html .

CONTRACT ADMINISTRATION REQUIREMENTS

What are the new Contract Administration requirements?
There are a number of new provisions designed to prevent unfair practices that adversely affect DBEs. These contract provisions are incorporated into the Contract Documents as follows:

1) Payment of subcontractors: Contractor shall pay subcontractors for satisfactory performance no later than 30 days from the prime contractor's receipt of payment from the loan recipient.

2) DBE termination: Contractor shall notify loan recipient in writing prior to any termination of a DBE subcontractor for failure to complete work under a subcontract with the prime contractor.

3) Replacing a DBE subcontractor: If a DBE subcontractor fails to complete work under the subcontract for any reason, the prime contractor shall employ the six good faith efforts if soliciting a replacement subcontractor.

4) Implementing good faith efforts: Contractor shall employ the six good faith efforts even if the prime contractor has achieved the fair share objectives.

CWFP / SDWLP REQUIRED CONTRACT CONDITIONS

This project is being financed in whole or in part by the Wisconsin Department of Natural Resources through the Clean Water Fund Program (CWFP) or the Safe Drinking Water Loan Program (SDWLP). ~~Municipalities constructing projects designated as federal equivalency must comply with the following federal laws and all applicable state and federal laws, rules and regulations and must ensure that their contractor(s) also comply with these laws, rules and regulations.~~ These requirements are incorporated by reference as contract provisions in the Contract Documents.

~~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 11246, as amended by Executive Orders 11375 and 12086 and subsequent regulations. Prohibits employment discrimination on the basis of race, color, religion, sex or national origin. Inclusion of the seven clauses in Section 202 of E. O. 11246 as amended by E. O. 11375 and 12086 are required in all project related contracts and subcontracts for municipalities over 3,300 population.~~

~~3) 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 ("EPA's 8% statute"); Public Law 101-549, Title X of the Clean Air Acts Amendments of 1990 (42 U.S.C. 7601 note) ("EPA's 10% statute"). 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.~~

~~4) 40 CFR Part 33 Participation by Disadvantaged Business Enterprises in Procurement under Environmental Protection Agency (EPA) Financial Assistance Agreements~~

~~5) Executive Order 12549, 3 CFR, 189 and 40 CFR Part 32, Subparts B and C. Prohibits entering into contracts or sub-contracts with individuals or businesses who are debarred or suspended. Borrowers are required to check the status of all contractors (construction and professional services) and must require contractors to check the status of subcontractors for contracts expected to be equal to or over $25,000 via this Internet address: http://epls.arnet.gov/.~~

~~6) Executive Order 13202, as amended by Executive Order 13208, does not allow bid specifications, project agreements or other controlling agreements to require or prohibit bidders, contractors or subcontractors to enter into or to adhere to project labor agreements.~~

7) Section 513 of the Federal Water Pollution Control Act (33 USC 1372) or Section 1450(e) of the Safe Drinking Water Act (42 USC 300j-9(e)), as applicable, which requires that all laborers and mechanics employed by contractors and subcontractors on projects funded directly by or assisted in whole or in part by and through the Federal Government pursuant to this Act shall be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by the Secretary of labor in accordance with subchapter IV of chapter 31 of title 40, United States Code. With respect to the labor standards specified in this section, the Secretary of Labor has the authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (64 Stat. 1267; 5 U.S.C. App.) and section 3145 of title 40, United State Code. **Please note this provision ("Davis-Bacon) applies to ALL loan recipients. See Wage Rates section of contract documents.**

WISCONSIN DNR
ENVIRONMENTAL LOAN PROGRAM
AMERICAN IRON AND STEEL (AIS) REQUIREMENTS

On January 17, 2014, Congress enacted H.R. 3547, "Consolidated Appropriations Act, 2014", which includes the funding provisions for both the CWFP and the SDWLP. Included with the appropriation are "Buy American" requirements relating to the use of American iron and steel. These requirements apply to all CWFP and SDWLP projects for which plans and specifications are approved after January 17, 2014.

Congress specified that all of the iron and steel products used in a project must be produced in the United States. Iron and steel products are defined as the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

Implementation

The Act states:

Sec. 436. (a)(1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j–12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term ‘‘iron and steel products’’ means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the ‘‘Administrator’’) finds that—

(1) applying subsection (a) would be inconsistent with the public interest;

(2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

(3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

(e) The Administrator may retain up to 0.25 percent of the funds appropriated in this Act for the Clean and Drinking Water State Revolving Funds (CWSRF) for carrying out the provisions described in subsection (a)(1) for management and oversight of the requirements of this section.

(f) This section does not apply with respect to a project if a State agency approves the engineering plans and specifications for the project, in that agency's capacity to approve such plans and specifications prior to a project requesting bids, prior to the date of the enactment of this Act. The following questions and answers provide guidance for implementing and complying with the AIS requirements:

Covered Iron and Steel Products

For purposes of this CWSRF project that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the facility:

- Lined or unlined pipes or fittings;
- Manhole Covers;
- Municipal Castings (defined in more detail below);
- Hydrants;
- Tanks;
- Flanges;
- Pipe clamps and restraints;
- Valves;
- Structural steel (defined in more detail below);
- Reinforced precast concrete; and
- Construction materials (defined in more detail below).

'Primarily iron or steel' places constraints on the list of products above. For one of the listed products to be considered subject to the AIS requirements, it must be made of greater than 50% iron or steel, measured by cost. The cost should be based on the material costs.

For example, the iron portion of a fire hydrant would likely be the bonnet, body and shoe, and the cost then would include the pouring and casting to create those components. The other material costs would include non-iron and steel internal workings of the fire hydrant (i.e., stem, coupling, valve, seals, etc). However, the assembly of the internal workings into the hydrant body would not be included in this cost calculation. If one of the listed products is not made primarily of iron or steel, United States (US) provenance is not required. An exception to this definition is reinforced precast concrete.

Steel means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel and other specialty steels.

Production in the United States of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

Raw materials, such as iron ore, limestone, scrap iron, and scrap steel, can come from non-US sources.

Only the above listed products made primarily of iron or steel, permanently incorporated into the project must be produced in the US. For example trench boxes, scaffolding or equipment, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings are:

- Access Hatches;
- Ballast Screen;
- Benches (Iron or Steel);
- Bollards;
- Cast Bases;
- Cast Iron Hinged Hatches, Square and Rectangular;
- Cast Iron Riser Rings;
- Catch Basin Inlet;
- Cleanout/Monument Boxes;
- Construction Covers and Frames;
- Curb and Corner Guards;
- Curb Openings;
- Detectable Warning Plates;
- Downspout Shoes (Boot, Inlet);
- Drainage Grates, Frames and Curb Inlets;
- Inlets;
- Junction Boxes;
- Lampposts;
- Manhole Covers, Rings and Frames, Risers;
- Meter Boxes;
- Service Boxes;
- Steel Hinged Hatches, Square and Rectangular;
- Steel Riser Rings;
- Trash receptacles;
- Tree Grates;
- Tree Guards;

- Trench Grates; and
- Valve Boxes, Covers and Risers.

Structural steel is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered "structural steel". This includes, but is not limited to, the following products: wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), welding rods, decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors, and stationary screens.

Mechanical and electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples (including their appurtenances necessary for their intended use and operation) are NOT considered construction materials: pumps, motors, gear reducers, drives (including variable frequency drives (VFDs)), electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators), mixers, gates, motorized screens (such as traveling screens), blowers/aeration equipment, compressors, meters, sensors, controls and switches, supervisory control and data acquisition (SCADA), membrane bioreactor systems, membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, analytical instrumentation, and dewatering equipment.

Production in the US of the iron or steel used in a listed product requires that all manufacturing processes must take place in the United States, except metallurgical processes involving refinement of steel additives.

While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing bar and wire must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin. If the reinforced concrete is cast at the construction site, the reinforcing bar and wire are considered to be a construction material and must be produced in the US.

Compliance

In order to ensure compliance with the AIS requirement, the Contractor must provide certification of all contract language that has been included in the contract agreement. The Contractor must certify that all

iron and steel products used in the project are produced in the United States per Section 436 of H.R. 3547, "The Consolidated Appropriations Act, 2014"

The certification process is a method to ensure that Contractor, subcontractor, suppliers and manufacturers adhere to the AIS requirement and the Owner can verify that products comply with the AIS requirement. The process also establishes accountability and better enables States to take enforcement actions against violators. Certification can be done by either the use of a step certification process or a final manufacture's certification. The Contractor shall collect and turn over all certifications to the Engineer.

Step certification creates a paper trail that documents the location of the manufacturing process involved with the production of steel and iron materials. A step certification is a process under which each handler (supplier, fabricator, manufacturer, processor, etc) of the iron and steel products certifies that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers the work along with a certification of its origin. A certification can be quite simple. Typically, it includes the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. A sample step certification is attached as Appendix A of this section.

Alternatively, the final manufacturer that delivers the iron or steel product to the worksite, vendor, or contractor, may provide a certification asserting that all manufacturing processes occurred in the US. . A sample step certification is attached as Appendix B of this section. Note that additional documentation may be needed if the certification is lacking important information.

Waivers

The statute permits the EPA to issue waivers for a case or category of cases where EPA finds (1) that applying these requirements would be inconsistent with the public interest; (2) iron and steel products are not produced in the US in sufficient and reasonably available quantities and of a satisfactory quality; or (3) inclusion of iron and steel products produced in the US will increase the cost of the overall project by more than 25 percent. A list of approved national waivers for materials includes:

- National Product Waiver for Pig Iron and Direct Reduced Iron (February 18, 2015)
- De Minimis Waiver Pursuant to Section 436 of P.L. 113-76, Consolidated Appropriations Act (CAA) (April 15, 2014)
- National Product Waiver for Minor Components in Iron and Steel Products (with Cost Ceiling) (October 27, 2015)
- Short-Term National Product Waiver for Stainless Steel Nuts and Bolts Used in Pipe Couplings, Restraints, Joints, Flanges, and Saddles (February 18, 2015) (One year extension provided on January 18, 2017)

More information on the national waivers can be found online at https://www.epa.gov/cwsrf/american-iron-and-steel-requirement-approved-national-waivers-0 .

Appendix A

Sample Step Certification

The following information is provided as a sample letter of step certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Step Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location:

_____

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Appendix B

Sample Final Certification

The following information is provided as a sample letter of certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location:

_____

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

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SECTION 01100

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Work.

B. Work by Owner.

C. Contractor use of sites.

D. Work sequence.

E. Owner occupancy.

F. Field Verification Of Drawing Information

G. Archaeological Finds

1.2 DESCRIPTION OF WORK

A. Work on the Project will be provided under a single prime contract.

B. The major facilities or components of the Project include, but are not limited to the following. To determine the full scope of the Project, refer to the entire Contract Documents:
   1. Construction of two (2) 16-inch diameter force mains and sanitary sewer vault.
   2. Construction of a new N. Chicago Ave Lift Station, including the following:
      a. Construction of a wetwell.
      b. Construction of a lift station building.
      c. Installation of an existing emergency generator.
      d. Instrumentation and control work.
      e. Heating, ventilating and air conditioning (HVAC) work.
      f. Miscellaneous piping work.
      g. Electrical work.
      h. Site work.
      i. Yard piping work.
      j. Selected demolition of existing facilities.

C. Any part or item of the work that is reasonable implied or normally required to make each installation satisfactorily operable shall be performed by the Contractor and the expense thereof shall be included in the applicable prices bid for the work. It is the intent of these Specifications to provide the Owner with complete operable systems, subsystems, and other items of work. All miscellaneous appurtenances and other items of work that are incidental to meeting the intent of these Specifications shall be

considered as having been included in the applicable prices bid for the work even though these appurtenances and items may not be specifically called for in the Specifications.

1.3 WORK BY OWNER

A. Items noted “By Owner”, “Not In Contract”, or “By Others” will be provided by Owner.

B. Owner’s Responsibilities:
1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples, to Contractor.
2. Arrange and pay for delivery to site.
3. On delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, effective, or deficient items.
5. Arrange for manufacturers’ warranties, inspections, and service.

C. Contractor’s Responsibilities:
1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

D. Products furnished to site and installed by Owner: “Provided by Owner”.

E. Items furnished by Owner for installation by Contractor: “Owner-furnished, contractor-installed”.

F. Work by Other Contractors: “By Others”.

1.4 CONTRACTOR USE OF SITES

A. Confine operations at sites to areas permitted by:
1. Law.
2. Ordinances.
3. Permits.
4. Contract Documents.

B. Storage:
1. Assume full responsibility for protection and safekeeping of material and products stored on or off premises.
2. Move any stored material or products that interfere with operations of Owner or other Contractors.
3. Obtain and pay for use of additional storage or work areas needed for operation.

C. Time Restrictions for Performing Work: During normal weekday working hours; 7:00 AM to 5:00 PM. No work shall be done between 5:00 P.M. and 7:00 A.M. nor on Sundays or legal holidays without the written permission of the Owner. However, emergency work during these hours may be done without prior permission.

D. All power outages shall be scheduled and coordinated with the Owner to minimize or avoid interruptions to lift station operations.

E. Night work may be established by the Contractor as regular procedure with the written permission of the Owner and at no additional cost to the Owner. Such permission, however, may be revoked at any time by the Owner if the Contractor fails to maintain adequate equipment and supervision for the proper execution and control of the work at night. Contractor shall provide adequate staff to respond to problems arising from the work at night. Contractor shall provide repairs as necessary to maintain plant operations. If the Contractor fails to respond in a manner deemed adequate to the Owner, the Owner reserves the right to make emergency repairs to maintain critical operations. The Owner will bill the Contractor for all labor and materials needed to affect such repairs.

1.5 WORK SEQUENCE

A. Due to potential health hazards and requirements of State of Wisconsin, DNR and U.S. EPA, existing wastewater pumping facilities must be maintained in continuous operation during construction. Degree of pumping capacity during construction shall be equal to or exceed the capacity of the lift station before the start of construction.

B. The Contractor shall be fully responsible for providing all temporary piping, plumbing, electrical hook-ups, heating, ventilating, air conditioning, lighting, temporary structures, and related work to maintain lift station operations. All details of temporary piping and temporary construction are not necessarily shown on the Drawings or covered in the Specifications. However, this does not relieve the Contractor of the responsibility to maintain wastewater pumping operation.

C. The Contractor shall provide a schedule and conduct construction activities in such a manner as to allow the Owner's personnel to operate the lift station facilities. The Contractor shall conduct operations in a manner necessary to minimize disturbance or disruption of lift station operation.

1. The Contractor’s construction schedule for the Work shall generally be as follows:
    a. Remove and replace existing structures and sewer that interfere with construction of new facilities.
    b. Provide temporary bypass pumping as required by Section 01500.
    c. Construct new sewer and force mains, new lift station, and complete startup of new equipment.
    d. Complete demolition work on existing lift station.
    e. Complete new sewers, and terminate temporary pumping.
    f. Complete site restoration work and pavement.
    g. Complete all controls work, punchlist items and move off site.
2. The general construction sequence for the construction includes the following constraints:
    a. Storm sewer and sanitary outfalls may not be placed from March 15th to May 15th.
    b. The existing lift station must be kept in service until the new facilities have started operation.
3. Sequence the construction of the new force mains from the new lift station and its connection to the collection system. Coordinate the tie-in of the new force mains

from the new lift station to the collection system. Provide bypass pumping and piping or hauling as needed to complete the force main construction.

4. The general sequence of construction outlined is necessary to permit efficient use of the existing facilities during construction and to expedite construction and operation of the new facilities. The general sequence includes only the work to be performed on major facilities and structures, and work required to maintain adequate lift station operations.
5. The outline presented herein is intended only to identify the relationships between various construction activities required to execute the construction while maintaining lift station operations. The outline does not attempt to define time requirements or durations for the completion of the individual tasks. The Contractor shall be responsible for establishing the schedule for construction as specified in Section 01323, NETWORK ANALYSIS SCHEDULES.
6. The Contractor may propose an alternate sequence of activities which allows the work to occur while maintaining operation. Any alternate schedules and sequences shall be subject to review and approval by the Engineer prior to implementation by the Contractor.
7. Coordinate the modification and replacement of existing equipment and structures with the Owner. Do not take any existing equipment or structure out of service without prior notification to the Owner.

D. Coordinate, schedule and make final tie-ins of new connections to existing utilities, piping, and equipment. Tie-ins shall be scheduled by the Contractor to minimize interruption of collection system operation. Contractor shall receive approval from the Owner prior to taking any existing utility or piping out of service. Provide at least 24 hours advance notice to the Owner of all proposed connections to existing piping. Tie-ins will be required for, but not be limited to electric, water utilities, sanitary sewer, andfinished water piping. Contractor shall be responsible for disconnecting the piping, draining liquid from the piping if necessary, and cleanup of the area.

E. Schedule the completion of installation of all underground piping and conduits prior to commencing surface restoration in any area.

F. Schedule modifications to existing buildings to avoid or minimize disruptions to Owner’s ongoing operations and maintenance work. In general, modifications to existing buildings should be scheduled in the time periods described in this Section.

1.6 OWNER OCCUPANCY

A. The Owner will require access to the existing lift station site during entire period of construction to conduct normal operations.

B. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.

1.7 FIELD VERIFICATION OF DRAWING INFORMATION

A. The Contractor shall field verify the size and location of existing structures, equipment, and piping depicted on the Drawings. Information on the Drawings is based upon available record drawings. No attempt has been made to verify the accuracy of the record

drawings. Contractor shall be responsible for locating all buried pipelines and utilities prior to excavation.

1.8 ARCHAEOLOGICAL FINDS

A. Provide protection around known archeological features if shown on the Drawings. Protection shall remain in place until Final Completion.

B. Provide for the preservation and protection of materials of an archaeological nature should such materials be uncovered in the course of the Work.

C. Notify Engineer immediately upon discovery of such materials and stop work in the vicinity of the find.

D. All finds are the property of the Owner. Do not remove or disturb finds without the Owner's written authorization.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01200

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cash allowances.

B. Contingency allowances.

C. Testing and inspection allowances.

D. Schedule of values.

E. Applications for payment.

F. Change procedures.

G. Defect assessment.

H. Unit prices.

I. Alternates.

1.2 CASH ALLOWANCES

A. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, less applicable trade discounts, delivery to site and applicable taxes.

B. Costs Not Included in Cash Allowances but Included in Contract Sum/Price: Product handling at site, including unloading, uncrating, and storage; protection of products from elements and from damage; labor for installation and finishing.

C. Architect/Engineer Responsibilities:
1. Consult with Contractor for consideration and selection of products, services, suppliers, and installers.
2. Select products and services in consultation with Owner and transmit decision to Contractor.
3. Prepare Change Order.

D. Contractor Responsibilities:
1. Assist Architect/Engineer in selection of products, services suppliers and installers.
2. Obtain proposals from suppliers and installers and offer recommendations.
3. On notification of selection by Architect/Engineer, execute purchase agreement with designated supplier and installer.

4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.

E. Differences in costs will be adjusted by Change Order.

F. Allowances Schedule: The Contractor shall include in the total base bid price the following cash allowances:
1. Replacement Allowance: Replacement of existing piping, valves, wiring, conduit, and other miscellaneous materials required to incorporate the new equipment and facilities. This cash allowance shall apply only for the replacement of existing items or materials that are specified to be re-used and are required to complete the work but that cannot be reused or left in place because of their condition, location, or suitability, and shall not be applied to items shown or specified to be removed and replaced: **Cash allowance: $25,000.**
2. Asbestos and Lead Removal Allowance: Testing, removal and disposal of materials containing lead or asbestos that exceeds regulatory limits: **Cash allowance: $10,000.**
3. Skilled Trades Crew Allowance: Skilled trades crew to perform modifications during startup as specified in Section 01650: **Cash allowance: $5,000.**
4. Radio Tower Allowance: Provision of the specified radio tower per specification 13790. Design of the tower to be determined by the required radio study: **Cash allowance: $20,000.**
5. Programming Allowance: Skilled trades crew to complete programming modifications to the existing SCADA system per the requirement of Sections 13320 and 13323: **Cash allowance: $10,000.**
6. Computer Systems Equipment Allowance: Purchase of Owner-selected equipment additions to SCADA computer systems. Included in this allowance is hardware and software and configuration that is required by the System Integrator to complete SCADA system computer upgrades per Sections 13320 and 13321: **Cash allowance: $30,000.**
7. Utilities Allowance: Payment of the charges from utility companies for extending services to the new facilities: **Cash allowance: $10,000.**

1.3 TESTING AND INSPECTION ALLOWANCES

A. Testing and Inspecting Allowances Schedule: Include sum of **$10,000** for payment of testing, inspecting, and laboratory services specified in Section 01400.

B. Costs Included in Testing and Inspecting Allowances: Cost of engaging testing and inspecting agency; execution of tests and inspecting; and reporting results.

C. Costs Not Included in Allowance but Included in Contract Sum/Price:
1. Costs of incidental labor and facilities required to assist testing or inspecting agency.
2. Costs of testing services used by Contractor separate from Contract Document requirements.
3. Costs of retesting upon failure of previous tests as determined by Architect/Engineer.

D. Payment Procedures:
   1. Submit copies of inspecting or testing firm's invoice with next application for payment.
   2. Pay invoice on approval by Architect/Engineer.

E. Differences in cost will be adjusted by Change Order.

1.4 SCHEDULE OF VALUES

A. Submit printed schedule on EJCDC C-620-2013. Contractor's standard form or electronic media printout will be considered.

B. Submit Schedule of Values in triplicate as specified in Article 2 of the General Conditions.

C. Format: Values shall be broken down by each of the major buildings or facilities as described in the Contract Document. For each of the major facilities, utilize the Table of Contents of this Project Manual to further break down the costs. Identify each line item with number and title of the major specification Section. Identify site mobilization, bonds and insurance.

D. Include a line item for the amount of Allowances specified in this section.

E. Include within each line item, direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.5 APPLICATIONS FOR PAYMENT

A. Submit three copies of each application on form EJCDC C-620-2013. Contractor’s electronic media driven form will be considered.

B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

C. Submit updated construction schedule with each Application for Payment.

D. Payment Period: Submit at intervals stipulated in the Agreement.

E. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Partial release of liens from major subcontractors and vendors.
   2. Record documents as specified in Section 01700, for review by Owner which will be returned to Contractor.
   3. Copies of invoices, certificates of insurance, and affidavits attesting to off-site stored products.
   4. Construction progress schedules, revised and current as specified in Section 01323.

1.6 CHANGE PROCEDURES

A. Maintain detailed records of work done on a Cost of Work basis. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in the Work.

B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of the quotation.

C. On request, provide additional data to support computations:
   1. Quantities of products, labor, and equipment.
   2. Taxes, insurance and bonds.
   3. Overhead and profit.
   4. Justification for any change in Contract Time.
   5. Credit for deletions from Contract, similarly documented.

D. Support each claim for additional costs, and for work done on a Cost of Work basis, with additional information:
   1. Origin and date of claim.
   2. Dates and times work was performed, and by whom.
   3. Time records and wage rates paid.
   4. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

E. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price of Contract Time by issuing supplemental instructions on a Field Order

F. The Architect/Engineer may issue a Proposal Request including a detailed description of proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change. Contractor will prepare and submit estimate within 10 days.

G. Contractor may propose changes by submitting a request for change to Architect/Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 01600.

H. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Architect/Engineer.

I. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work that are not pre-determined, execute Work under Work Directive Change. Changes in Contract Sum/Price or Contract Time will be computed as specified for Time and Material Change Order.

J. Work Directive Change: Architect/Engineer may issue directive, on EJCDC C-940-2013 Work Directive Change signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.

K. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Architect/Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.

L. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

M. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.

N. Change Order Forms: EJCDC C-941 Change Order.

O. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

P. Correlation Of Contractor Submittals:
1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
3. Promptly enter changes in Project Record Documents.

1.7 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements in accordance with article 13 of the General Conditions.

B. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from transporting vehicle.
4. Products placed beyond lines and levels of required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected products.

1.8 UNIT PRICES

A. Not Used.

1.9 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option in accordance with Article 11 of Instructions to Bidders. Accepted Alternates will be identified in Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.

B. Field engineering.

C. Preconstruction meeting.

D. Site mobilization meeting.

E. Progress meetings.

F. Pre-installation meetings.

G. Cutting and patching.

H. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements with provisions for accommodating items installed later.

B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.

F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

G. Coordinate trench excavation and backfill activities with surface restoration work.

1.3 FIELD ENGINEERING

A. Locate and protect survey control and reference points. Promptly notify Architect/Engineer of discrepancies discovered.

B. Control datum for survey is that shown on Drawings.

C. Verify set-backs and easements; confirm drawing dimensions and elevations.

D. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

E. Submit copy of site drawing and certificate signed by Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.

F. Establish elevations, lines and levels. Locate and lay out instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structure.
   3. Building foundation, column locations, ground floor elevations.

G. Periodically verify layouts by same means.

H. If applicable perform surveys to determine quantities of unit cost work, including control surveys to establish measurement reference lines. Notify Engineer prior to starting work.

I. Contractors shall sign surveyor's field notes or keep duplicate field notes and calculate and certify quantities for payment purposes.

J. Maintain complete and accurate log of control and survey work as Work progresses.

K. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

L. Promptly report to Architect/Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.

M. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

1.4 PRECONSTRUCTION MEETING

A. Architect/Engineer will schedule meeting and administer meeting after Notice to Proceed.

B. Attendance Required: Owner, Architect/Engineer, Contractor and major subcontractors.

C. Agenda:
   1. Submission of executed bonds and insurance certificates.
   2. Distribution of Contract Documents.
   3. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
   4. Designation of personnel representing parties in Contract and Architect/Engineer.
   5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   6. Scheduling.
   7. Security and housekeeping procedures.
   8. Procedures for maintaining record documents.
   9. Erosion control and dewatering requirements.

D. Architect/Engineer will record minutes and distribute copies within two days after meeting to participants, with two copies to Architect/Engineer, Owner, and those affected by decisions made.

1.5 PROGRESS MEETINGS

A. Architect/Engineer will schedule and administer meetings throughout progress of the Work at maximum monthly intervals.

B. Architect/Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Job superintendent, project manager, major subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
   1. Review minutes of previous meetings.
   2. Review of Work progress.
   3. Field observations, problems, and decisions.
   4. Identification of problems impeding planned progress.
   5. Review of submittals schedule and status of submittals.
   6. Review of off-site fabrication and delivery schedules.
   7. Maintenance of progress schedule and corrective measures to regain projected schedules.
   8. Planned progress during succeeding work period and coordination of projected progress.
   9. Maintenance of quality and work standards.
   10. Request for information items.
   11. Work change directives / change order items, and the effect of proposed changes on progress schedule and coordination.
   12. Safety issues.
   13. Pay request status.
   14. Other business relating to Work.

E. Architect/Engineer will record minutes and distribute copies within two days after meeting to participants, with copies to Architect/Engineer, Owner, and those affected by decisions made.

1.6 PRE-INSTALLATION MEETINGS

A. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify Architect/Engineer seven days in advance of meeting date.

D. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect/Engineer, Owner, and those affected by decisions made.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements affecting:
1. Structural integrity of element.
2. Integrity of weather-exposed or moisture-resistant elements.
3. Efficiency, maintenance, or safety of element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate contractor.

C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
1. Fit the several parts together, to integrate with other Work.
2. Uncover Work to install or correct ill-timed Work.
3. Remove and replace defective and non-conforming Work.
4. Remove samples of installed Work for testing.
5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

E. After uncovering existing Work, assess conditions affecting performance or work.

F. Beginning of cutting or patching means acceptance or existing conditions.

G. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

H. Provide protection from elements for areas that may be exposed by uncovering work.

I. Maintain excavations free of water.

J. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.

K. Cut masonry and concrete materials using masonry saw or core drill.

L. Restore Work with new products in accordance with requirements of Contract Documents.

M. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

N. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

O. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Specifications, to full thickness of penetrated element.

P. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.

Q. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

3.2 SPECIAL PROCEDURES

A. Materials: As specified in product sections; match existing with new products for patching and extending work.

B. Employ skilled and experienced installer to perform alteration work.

C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

E. Remove debris and abandoned items from area and from concealed spaces.

F. Prepare surface and remove surface finishes to permit installation of new work and finishes.

G. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.

H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original condition.

I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.

J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.

K. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.

L. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plant without breaks, steps, or bulkheads.

M. Where change of plane of ¼ inch or more occurs, submit recommendation for providing smooth transition; to Architect/Engineer for review.

N. Trim existing doors to clear new floor finish. Refinish trim to original or specified condition.

O. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

P. Finish surfaces as specified in individual product sections.

END OF SECTION

SECTION 01323

NETWORK ANALYSIS SCHEDULES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. References.

B. Quality assurance.

C. Format.

D. Schedules.

E. Submittals.

F. Review and evaluation.

G. Updating schedules.

H. Distribution.

1.2 REFERENCES

A. The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry, Washington, D.C., The Associated General Contractors of America (AGC).

1.3 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or Specialist Consultant specializing in CPM scheduling with two years minimum experience in scheduling construction work of complexity comparable to this Project, and having use of computer facilities capable of delivering detailed graphic printout within 48 hours of request.

B. Contractor's Administrative Personnel: two years minimum experience in using and monitoring CPM schedules on comparable projects.

1.4 FORMAT

A. Listings: Reading from left to right, in ascending order for each activity. Identify each activity with applicable specification section number.

B. Diagram Sheet Size: 11 inches high x 17 inches wide.

C. Scale and Spacing: To allow for notations and revisions.

1.5 SCHEDULES

A. Prepare network analysis diagrams and supporting mathematical analyses using Critical Path Method, under concepts and methods outlined in AGC's "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry".

B. Illustrate order and interdependence of activities and sequence of work; how start of given activity depends on completion of preceding activities, and how completion of activity may restrain start of subsequent activities.

C. Illustrate complete sequence of construction by activity, identifying work of separate structures or facilities. Indicate dates for submittals and return of submittals; dates for procurement and delivery of critical products; and dates for installation and provision for testing. Include legend for symbols and abbreviations used.

D. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
   1. Preceding and following event numbers.
   2. Activity description.
   3. Estimated duration of activity, in maximum 7-day intervals.
   4. Earliest start date.
   5. Earliest finish date.
   6. Actual start date.
   7. Actual finish date.
   8. Latest start date.
   9. Latest finish date.
   10. Total and free float; accrue float time to Owner and to Owner's benefit.
   11. Monetary value of activity, keyed to Schedule of Values.
   12. Percentage of activity completed.
   13. Responsibility.

E. Analysis Program: Capable of compiling monetary value of completed and partially completed activities, of accepting revised completion dates, and recomputation of scheduled dates and float.

F. Required Sorts: List activities in sorts or groups:
   1. By preceding work item or event number from lowest to highest.
   2. By longest float, then in order of early start.
   3. By responsibility in order of earliest possible start date.
   4. In order of latest allowable start dates.
   5. In order of latest allowable finish dates.
   6. Contractor's periodic payment request sorted by Schedule of Values listings.
   7. Listing of basic input data generating report.
   8. Listing of activities on critical path.

G. Prepare sub-schedules for each stage of Work identified in Summary of Work, Section 01100.

H. Coordinate contents with schedule of values in Price and Payment Procedures, Section 01200.

1.6 SUBMITTALS

A. Within 20 days after date of Owner-Contractor Agreement, submit proposed preliminary network diagram defining planned operations for first 60 days of Work, with general outline for remainder of Work.

B. Participate in review of preliminary and complete network diagrams jointly with Architect/Engineer.

C. Within 20 days after joint review of proposed preliminary network diagram, submit draft of proposed complete network diagram for review. Include written certification that major Subcontractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete network analysis consisting of network diagrams and mathematical analysis.

E. Submit updated network schedules with each Application for Payment.

F. Submit number of opaque reproductions Contractor requires, plus three copies Architect/Engineer will retain.

G. Submit under transmittal letter form specified in Submittal Procedures, Section 01330.

1.7 REVIEW AND EVALUATION

A. Participate in joint review and evaluation of network diagrams and analysis with Architect/Engineer at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise network diagrams and analysis incorporating results of review, and resubmit within 10 days.

1.8 UPDATING SCHEDULES

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update diagrams to graphically depict current status of Work.

C. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

D. Indicate changes required to maintain Date of Substantial Completion.

E. Submit sorts required to support recommended changes.

F. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect including effects of changes on schedules of separate contractors.

1.9 DISTRIBUTION

A. Following joint review, distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Architect/Engineer, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 PRODUCTS

Not Used.

2.1 EXECUTION

Not Used.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Requirements for submittal types.

1.2 SUBMITTAL PROCEDURES

A. Electronic Submittal Management:
   1. Submittals shall be transmitted to Architect/Engineer in electronic format using an online submittal management service designed specifically for transmitting submittals and other project documents between construction team members.
   2. The submittal management service shall be capable of storing and displaying a submittal log and all project submittals. The Submittal Log and all Submittal information must be printable and continuously accessible via the Internet. Provide uploading and editing capabilities for contractors, Architect/Engineer, and Owner.
   3. The submittal management service shall automatically record the date submittals are uploaded or edited, comments and submittal status, the name of the person taking action, shall issue automatic notifications to the parties who must next act on the submittal, and identify submittal due dates.
   4. The submittal management service shall provide an electronic file archive of all submittals and other contract documents as a download in PDF file format at project completion.
   5. The cost of the project interactive website services shall be included in the Contractor's bid.
   6. Approved Vendors:
      a. Newforma Project Cloud, Newforma.
      b. Submittal Exchange, Textura Corporation.

B. Submittal formatting requirements:
   1. Contractor shall produce electronic submittals in PDF format for product data, shop drawings, design data, test reports, certificates, manufacturer's instructions, erection drawings, and all other specific documentation required.
   2. Submittal file names shall begin with the specification section and include the ID tag number and .pdf file extension. File naming conventions will also include submittal revision number as appropriate.
   3. Individual file size shall be limited to 10 MB. If the submittal is required to be divided into more than one file, a letter extension shall be added to the end of each filename.
   4. The resolution of scanned images shall be a minimum of 300 dpi unless otherwise requested. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 8 or higher). Files shall provide a clear

image with optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. Successful searches for words or strings in the pdf documents shall demonstrate proof of OCR.

5. All submittals must be indexed with the Adobe catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems transferring files.
6. Rotate pages viewed in landscape to the appropriate position for easy reading.
7. Provide bookmarks at appropriate chapter, section, and subsection divisions. Thumbnails shall be generated and embedded in each pdf file.
8. Files shall be delivered without security features activated. Password protected files are not acceptable.
9. Contractor shall re-process any portion of the submittal file(s) that does not view or print to Owner's satisfaction.

C. General Submittal Requirements

1. Submit only one specification section per transmittal, and submit all items in a particular specification section at the same time.
2. Transmit each submittal with a cover sheet.
   a. Provide space on submittal cover sheet for Contractor and Architect/Engineer review stamps.
   b. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
3. Provide equipment tag numbers on data sheets and product descriptions.
4. Indicate the applicable specification section, paragraph, and subparagraph numbers on the manufacturer's data sheets and product literature.
5. Clearly mark the selected product by use of arrows, underlines, or circles where more than one product is shown. Use of highlighters to identify the selected product is unacceptable. Faxed copies are not acceptable and will be rejected.
6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
7. When revised for resubmission, identify changes made since previous submission.

D. Submittal Review and Processing:

1. Allow 15 days for each submittal review and processing.
2. Unrequested submittals will be returned without review.
3. Each submittal will receive up to two reviews by the Engineer at no cost to the Contractor. If a given submittal fails to reach a completed status (reviewed and marked "Approved" or "Approved as Noted") on the second submittal, the Contractor shall have the costs associated with further reviews by the Engineer deducted from the Contract Amount. These costs will be computed at a rate of $100 per hour for Engineer review time.
4. Samples and color charts should be shipped via mail to the Architect/Engineer; sample submittal review will be completed electronically.

E. The Contractor shall provide one hardcopy of submittals to the Resident Engineer at the job site as requested.

F. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

1.3 PRODUCT DATA

A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Provide copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review distribute in accordance with Submittal Procedures article above and provide copies for record documents described in Section 01720.

1.4 SHOP DRAWINGS

A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Shop drawings shall be accurate, distinct, and complete, and shall contain all required information, including satisfactory identification of items, units, and assemblies in relation to the Contract Drawings and Specifications.

D. Shop drawings shall be submitted by the Contractor. The review of such shop drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for correctness of dimensions, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by a letter accompanying the shop drawings, and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the shop drawings.

E. Shop drawings include shop drawings, product data and other submittals for both shop and field-fabricated items. Submit, as applicable, the following for all prefabricated or manufactured structural, mechanical, electrical, plumbing, process systems, and equipment:
   1. Shop drawings or equipment drawings, including dimensions, size and location of connections to other work, and weight of equipment.
   2. Catalog information and cuts.
   3. Installation or placing drawings for equipment, drives and bases.

4. Supporting calculations for equipment and associated supports specified to be designed by equipment manufacturers or suppliers.
5. Wiring and control diagrams of systems and equipment.
6. Complete manufacturer's specifications, including materials description and paint system.
7. List of special motor features being provided (i.e., space heaters, altitude corrections, thermal protectors, etc.).
8. Complete motor rating for all motors 5 HP and larger, including motor no-load, starting, and full-load current at rated voltage; full-load speed and full-load current at 110 percent voltage; motor efficiency and power factor at ½, ¾, and full load at rated voltage.
9. Performance data and pump curves.
10. Suggested spare parts list with current price information.
11. List of special tools required for checking, testing, parts replacement, and maintenance (special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics).
12. List of special tools furnished with the equipment.
13. List of materials and supplies required for the equipment before and during startup.
14. List of materials and supplies furnished with the equipment.
15. Samples of finish colors for selection.
16. Special handling instructions.
17. Requirements for storage and protection before installation.
18. Requirements for routine maintenance required before plant startup.
19. List of all requested exceptions to the Contract Documents.
20. Installation instructions.

1.5 SAMPLES

A. Samples: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

B. Samples for Selection as Specified in Product Sections:
1. Submit to Architect/Engineer for aesthetic, color, or finish selection.
2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Architect/Engineer selection.
3. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.

E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain one sample.

F. Reviewed samples that may be used in the Work are indicated in individual specification sections.

G. Samples will not be used for testing purposes unless specifically stated in specification section.

1.6 DESIGN DATA

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.7 TEST REPORT

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in duplicate.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.9 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Submittal Procedures.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Identify conflicts between manufacturer’s instructions and Contract Documents.

1.10 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit report electronically within 30 days of observation to Architect/Engineer for information.

C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

D. For equipment or product installation certifications the certificate shall state that, based on field inspection, the manufacturer's equipment or product is properly installed, lubricated, and ready for start-up and operation. The certificate shall be signed by an authorized representative of the manufacturer.

1.11 ERECTION DRAWINGS

A. Submit drawings for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

1.12 ADDITIONAL SUBMITTAL REQUIREMENTS

A. Refer to individual specification sections for additional submittal requirements. Conform to requirements specified herein and those additional requirements when preparing submittals under this section

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01400

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control and control of installation.

B. Tolerances

C. References.

D. Mock-up requirements.

E. Testing and inspection services.

F. Manufacturers' field services.

G. Examination.

H. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trades, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect/Engineer.

1.6 TESTING AND INSPECTION SERVICES

A. Owner will employ services of an independent firm to perform testing and inspection. Contractor shall pay for services from cash allowances specified in Section 01200.

B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Architect/Engineer.

C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect/Engineer or Owner.

D. Reports will be submitted by independent firm to Architect/Engineer, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Architect/Engineer and independent firm 24 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

H. Agency Responsibilities:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Architect/Engineer.
   7. Attend preconstruction meetings and progress meetings.

I. Agency Reports: After each test, promptly submit two copies of report to Architect/Engineer and to Contractor. When requested by Architect/Engineer, provide interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and specifications section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Results of tests.
   10. Conformance with Contract Documents.

J. Limits On Testing Authority:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and certification of proper installation as applicable, and to initiate instructions when necessary. Refer to Section 01330 - SUBMITTAL PROCEDURES, MANUFACTURERS' FIELD REPORTS article.

B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces and seal cracks or openings of substrate prior to applying next material or substance.

B. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01445

MANUFACTURER'S FIELD SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General.

B. Installation.

C. Performance Testing and Start-up.

D. Operator training.

1.2 GENERAL

A. The number of days for manufacturer's services stated in the Specifications shall be considered as the minimum number of days. Should additional time be required for services due to equipment malfunction or other problem, such time shall be at the expense of the manufacturer, supplier, or Contractor as applicable, with no change in Contract Price.

B. "Days" specified shall consist of 8 hour days on-site, excluding travel time.

C. The Contractor shall designate and provide one person to be responsible for scheduling, coordinating, and expediting the specified services. Scheduling the services shall be done in cooperation with, and with the prior approval of the Engineer and Owner. Such schedule shall be arranged with the appropriate subcontractors, manufacturers, and suppliers in sufficient time to assure their compliance with the service requirements.

1.3 INSTALLATION

A. Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems as many days as may be necessary to ensure proper installation and to resolve assembly or installation problems at the work site that are attributable to, or associated with, the equipment furnished. This requirement applies to manufacturers of all equipment furnished, whether or not specifically set forth in the Specifications.

B. Where a manufacturer's certificate is called for in the Specifications, the manufacturer's representative shall provide the attached certificate stating that the equipment or system has been installed in accordance with the manufacturer's instructions and has been inspected by a manufacturer's authorized representative, that it has been serviced with the proper initial lubricants, that applicable safety equipment has been properly installed, and that the proper electrical and mechanical connections have been made. This certification shall be provided to the Engineer prior to the start-up.

C. Functional (or run) testing is required for all equipment and systems. The manufacturer's representative shall supervise the functional test, which shall include checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. The Manufacturer's

Certificate of Proper Installation shall state that proper adjustments have been made and that the equipment or system is ready for plant start-up.

1.4 PERFORMANCE TESTING AND START-UP

A. Where field testing and start-up services are called for in the Specifications, or when technical assistance is necessary due to any malfunction of the equipment or system furnished, the manufacturer's representative shall provide such services. Manufacturer's representative shall also conduct and/or assist with performance testing, as required by the Specifications. These services shall continue until such times as the applicable equipment or system has been successfully tested for performance and has been accepted by the Owner for full-time operation.

B. Start-up of equipment and plant shall be in accordance with Manufacturer's instruction and Section 01650, Starting of Systems.

1.5 OPERATOR TRAINING

A. Where training is called for in the Specifications, provide competent and experienced technical representative to provide detailed instructions to Owner's personnel for operation of equipment. Training services shall include prestart-up classroom instruction and start-up on-site instruction, as stated in Specifications.

B. The Contractor shall coordinate the prestart-up training periods with Owner’s operating personnel and manufacturers' representatives.

C. All prestart-up training shall be completed 14 days prior to actual plant start-up.

D. Operating training shall be in accordance with Section 01650.

E. The Owner or Engineer shall have the right to videotape or otherwise electronically or photographically record all training sessions.

F. Contractor shall provide attached Certificate of Operator Training cosigned by Owner and supplier's representative, verifying training accomplished to satisfaction of all parties.

G. Operation and maintenance manual submitted in accordance with Section 01730, Operation and Maintenance Manuals, shall be approved prior to scheduling prestart-up operator training.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

CERTIFICATE OF PROPER INSTALLATION

Project _____

Equipment _____

Specification Section _____

Contract _____

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

MANUFACTURER'S REPRESENTATIVE

Signature _____ Date _____

Name (print) _____

Title _____

Representing _____

CONTRACTOR

Signature _____ Date _____

Name (print) _____

Title _____

This form shall be completed and submitted to Architect/Engineer prior to plant start-up.

CERTIFICATE OF OPERATOR TRAINING

Project _____

Equipment _____

Specification Section _____

Contract _____

I hereby certify the equipment supplier/manufacturer has instructed Owner's personnel in the start-up operation and maintenance of this equipment as required in the specifications.

MANUFACTURER'S REPRESENTATIVE

Signature _____ Date _____

Name (print) _____

Title _____

Representing _____

CONTRACTOR

Signature _____ Date _____

Name (print) _____

Title _____

OWNER

I hereby certify that my operating personnel received ____ days instruction from_____for start-up, operation, and maintenance of this equipment.

Signature _____ Date _____

Name (print) _____

Title _____

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary electricity.
   2. Temporary lighting for construction purposes.
   3. Temporary heating.
   4. Temporary ventilation.
   5. Temporary water service.
   6. Temporary sanitary facilities.

B. Construction Facilities:
   1. Vehicular access.
   2. Parking.
   3. Progress cleaning and waste removal.
   4. Project identification.
   5. Traffic regulation.

C. Temporary Controls:
   1. Barriers.
   2. Enclosures and fencing.
   3. Protection of the Work.
   4. Security.
   5. Water control.
   6. Dust control.
   7. Erosion and sediment control.
   8. Pollution control.

D. Removal of utilities, facilities, and controls.

E. Temporary Bypass Pumping System

1.2 TEMPORARY UTILITIES

A. Temporary Electricity
   1. Existing power service may be used at the existing lift station site. Owner will pay cost of electrical energy used for construction. Exercise measures to conserve energy.
   2. Power service at offsite areas shall be provided and paid for by the Contractor.
   3. Provide main service disconnect, over current protection, distribution and receptacles at convenient locations.
   4. Permanent power supply and convenience receptacles may be utilized during construction.
   5. Replace any components damaged during construction.

6. Complement existing power service capacity and characteristics as required for construction operations.
7. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.

B. Temporary Lighting For Construction Purposes
1. Provide and maintain lighting for safe construction operations as required. Permanent building lighting may be utilized during construction.
2. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.
3. Maintain lighting and provide routine repairs.
4. Permanent building lighting may be utilized during construction.

C. Temporary Heating
1. Existing facilities shall not be used.
2. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
3. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
4. Maintain minimum ambient temperature of 50 to 60 degrees F in areas where construction is in progress, unless indicated otherwise in product sections.

D. Temporary Ventilation: Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Telephone Service: Not required.

F. Internet Service: Provide, maintain and pay for internet service to field office and Architect/Engineer's field office at time of project mobilization.

G. Temporary Water Service: Provide and pay for suitable quality water service for potable uses.

H. Temporary Sanitary Facilities: Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

1.3 CONSTRUCTION FACILITIES

A. Vehicular Access
1. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.
2. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
3. Existing roadways within the plant must remain open at all times to allow for normal plant operations. Continuous access to existing plant buildings must be

provided at all times. Notify the Owner at least 48 hours prior to taking any roadway section out of service.

4. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.
5. Provide unimpeded access for emergency vehicles.
6. Provide and maintain access to fire hydrants free of obstructions.
7. Provide means of removing mud from vehicle wheels before entering streets. Brush roads clean as requested by Owner or Engineer, minimum weekly.

B. Parking

1. When site space is not adequate, provide additional off-site parking.
2. Use of existing on-site streets and driveways used for construction traffic is not permitted. Tracked vehicles not allowed on paved areas.
3. Use of existing parking facilities by construction personnel is not permitted.
4. Do not allow heavy vehicles or construction equipment in parking areas.
5. Permanent Pavements and Parking Facilities:
   a. Prior to Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
   b. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.
6. Maintenance:
   a. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
   b. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.
7. Removal, Repair:
   a. Remove temporary materials and construction at Substantial Completion.
   b. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
   c. Repair existing facilities damaged by use, to original condition.
8. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

C. Progress Cleaning And Waste Removal

1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.
2. Maintain existing plant roadways clean of mud and debris.
3. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.
4. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
5. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.
6. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

D. Project Identification

1. No signs will be allowed without Owner permission, except those required by law.

1.4 TRAFFIC MAINTENANCE

A. Through Traffic Access.

1. The Contractor shall maintain a minimum of one lane of traffic on streets at all times. Roads shall be maintained in a safe condition throughout the duration of the project. The Contractor shall take all precautions necessary to safely warn the public of the probable increased danger to travel due to construction of the Work. The Contractor shall prepare a traffic control plan and submit to the City Engineer's office for approval to the commencement of the work.

2. Plan shall show (at a minimum) advanced warning signage, lane closures, traffic barrels and barricades in accordance with the Wisconsin Manual of Uniform Traffic Control Devices and the Wisconsin Department of Transportation Facilities Development Manual and State Specifications.
   a. All streets shall be open to traffic after working hours and all day on weekends and holidays.
   b. The Contractor shall at all times conduct his work in a manner to minimize obstruction to local traffic.
   c. The Contractor shall inform all business owners on the last day of the previous week his intention for work to be performed the following week so as that the owners may schedule deliveries, etc. in advance without adverse impacts to their business.

B. Driveway Access.

1. If driveway access is to be blocked, then it shall be the Contractor's responsibility to notify affected property owners prior to closing that section of the street to traffic.
2. The Contractor shall construct temporary ramps at all driveways to provide access during construction. The cost of temporary ramps shall be incidental to the project.

C. Access to Businesses and Industries.

1. The Contractor shall provide full-time access to businesses and industries unless other satisfactory arrangements are made with the affected property prior to commencing the work. Access may be provided by constructing temporary drives that shall be considered incidental to the cost of the project. Access cannot be closed on any portion of two consecutive days to any property within the project limits.

D. Mail delivery.

1. The Contractor is responsible for insuring that mail can be delivered to properties affected by his work operations in a reasonable and timely manner.
2. If the Contractor's operations unduly restrict or prohibit mail delivery, he shall take measures to provide alternate method(s) for mail pick-up.

E. Signing, Barricades and Flag Persons.

1. Whenever the Contractor’s activities obstruct through traffic, there shall be sufficient flag persons on duty to guide the traffic, and the Contractor shall furnish and install all temporary signing and barricades required to safely direct the traveling public around the obstructed area.
    a. As a minimum, suitable barriers shall be erected and maintained at each end of the obstructed section of roadway and at all affected roadway intersections.
    b. All signing and barricades shall be done in accordance with the latest revision of Part VI, Traffic Controls for Construction and Maintenance Operations of the Wisconsin Manual of Uniform Traffic Control Devices, the Traffic Control Plan (as required by the Owner) and Section 643 of the State Specifications.

1.5 TEMPORARY CONTROLS

A. Barriers
1. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
2. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing building.
3. Provide protection for plants designated to remain. Replace damaged plants.
4. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

B. Enclosures And Fencing
1. Construction: Provide 7 feet high fence around construction site; equip with vehicular and pedestrian gates with locks.
2. Exterior Enclosures: Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

C. Security
1. Security Program:
    a. Protect Work, existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
    b. Initiate program in coordination with Owner's existing security system at project mobilization.
    c. Maintain program throughout construction period until Owner occupancy.
2. Entry Control:
    a. Restrict entrance of persons and vehicles into Project site and existing facilities.
    b. Allow entrance only to authorized persons with proper identification.
    c. Maintain log of workers and visitors, make available to Owner on request.

d. Owner will control entrance of persons and vehicles related to Owner's operations.

D. Water Control
1. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
2. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

E. Dust Control
1. Execute Work by methods to minimize raising dust from construction operations.
2. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.6 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion.

B. Remove underground installations to minimum depth of 2 feet. Grade site as indicated on Drawings.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.7 TEMPORARY BYPASS PUMPING SYSTEM

A. Provide all material, labor, equipment, and fuel to implement temporary pumping systems for the purpose of diverting raw sewage to permit the construction of the new lift station. Contractor shall be responsible for the design, installation, and operation of the temporary pumping systems.

B. Contractor shall provide adequate supervision, fuel, and materials to ensure operation of the temporary bypass system. Contractor shall be liable for all damages or fines caused by the failure to maintain operation of the temporary bypass systems.

C. Submit a detailed description of the temporary bypass systems, including information of the quantity, capacity, and location of all pumping equipment, pump manufacturer’s pump performance curves, and the size, type, and routing of all suction and discharge piping.

D. A temporary bypass system shall be installed at from Manhole E1-A to Manhole E1-1 (see Drawing 20-C-1). Suction piping shall be provided to the pumps from the manhole. Discharge piping shall be installed over the ground from each bypass system to the discharge point.

E. The Contractor shall provide the necessary start/stop controls for each pump.

F. Design Requirements:

Location	Total Flow Capacity
Sanitary Manhole E1-A	100 gpm

1.8 EROSION AND SEDIMENT CONTROL

A. General: Comply with the rules and policies promulgated or developed pursuant to Section 281.33 of the Wisconsin Statutes, conditions of Section NR 216 subchapter III, conditions of Section NR 110.15 (5) (n) of the Wisconsin Administrative Code, and the procedures outlined in the Storm Water Construction and Post-Construction Technical Standards, as published by the Wisconsin Department of Natural Resources, "Construction Site Erosion & Sediment Control".

B. General Erosion Control Measures:
1. Contractor shall follow the WDNR Storm Water Construction and Post-Construction Technical Standards for installation and maintenance of erosion control devices during construction (located on the WDNR website: http://dnr.wi.gov/runoff/stormwater/techstds.htm).
2. Provide the erosion control measures shown on the Erosion Control Plan in the Drawings.
3. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
4. Minimize surface area of bare soil exposed at one time.
5. Provide temporary measures including berms, dikes, and drains, and other devices to divert stormwater away from disturbed or exposed areas. Provide temporary sedimentation basins if shown on the Drawings.
6. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
7. Fertilizers and pesticides shall not be used in channel and swale areas.

C. General Maintenance Requirements:
1. Contractor shall conduct erosion and sediment control Best Management Practice inspections and submit maintenance logs on a weekly basis. The log and the weekly written reports of all inspections conducted shall be maintained by the Contractor at the construction site. Logs shall include the following information:
   a. Date of each inspection
   b. Name of Inspector
   c. Construction activity phase at date of inspection
   d. Description of findings during inspection
   e. Description of repairs or other actions undertaken
   f. List of needed actions and completion dates
2. All erosion control and storm water management practices will be checked for stability and operation every seven (7) days and within twenty-four (24) hours of any storm event producing at least 0.5 inches of rainfall. Any required repairs or replacements shall be made immediately within 24 hours of inspection or notification shall be made to the Department of Natural Resources (DNR).

3. All seeded areas, including ditches, shall be reseeded and mulched as necessary according to project specifications and plan practices to maintain a vigorous, dense vegetative cover.
4. Any drainage ditches experiencing excessive erosion and channel degradation due to high runoff volumes shall be re-graded and covered with biodegradable erosion control matting. Installation shall be per specifications for erosion control matting and manufacturer's recommendations.
5. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

D. Silt Fence:
1. A temporary sediment barrier consisting of a geotextile filter fabric stretched across and attached to supporting posts and entrenched.
2. Install in accordance with the contract drawings, and as located on the drawings, prior to disturbing the upslope area.
3. Remove after the disturbed area is stabilized by established seeding.
4. Silt fence filter fabric shall meet the requirements of WDNR Conservation Practice Standard 1056 and Section 628 of the State Specifications.
5. Maintenance:
    a. Repair or correct any damaged or decomposed fences, undercutting, or flow channels around the end of barriers.
    b. Dispose of sediment deposits that reach ½ the height of the fence.

E. Erosion Control Mat:
1. A manufactured blanket or mat made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, with a plastic or biodegradable mesh on one or both sides.
2. Products: Only mats listed in the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) will be used.
3. Erosion control mats shall meet the requirements of WDNR Conservation Practice Standards 1052 and 1053 and Section 628 of the State Specifications.
4. Install as located on the drawings and specified herein.
    a. The mat shall be installed after all topsoiling, fertilizing, liming and seeding is complete.
    b. Erosion mats shall extend for whichever is greater: upslope one-foot minimum vertically from the ditch bottom or 6 inches higher than the design flow depth.
    c. The mat shall be in firm and intimate contact with the soil. It shall be installed and anchored per the manufacturer's recommendation.
    d. At time of installation, document the manufacturer and mat type by retention of material labels and manufacturer's installation instructions. Retain this documentation until the site has been stabilized.
5. Maintenance:
    a. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per

manufacturer's recommendations. Additional staking is recommended near where drilling was filled.

b. If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

c. Maintenance shall be completed as soon as possible with consideration to site conditions.

F. Crushed Stone Tracking Pad

1. A stabilized pad of aggregate located at a point where traffic will egress a construction site.
2. Install (if necessary) as directed by City or Engineer
3. Material and installation shall comply with WDNR Conservation Practice Standard 1057.
4. If there are signs that the installation is ineffective, additional stone or re-construction may be required as directed.
5. Cost shall be incidental to the project.

G. Inlet Protection

1. A temporary device installed in or around a storm inlet.
2. Install in existing inlets where construction runoff is anticipated. In new installations, install immediately following inlet installation.
3. Material and installation shall comply with WDNR Conservation Practice Standard 1060.
4. Cost shall be incidental to the project.

H. Ditch Checks

1. A temporary dam constructed across a swale to reduce flow velocities.
2. Install as indicated on the project plans.
3. Material and installation shall comply with WDNR Conservation Practice Standard 1062.
4. If there are signs that the installation is infective, the ditch checks will be replaced by the contractor at no additional cost to the owner.
5. Cost of ditch checks shall be incidental to the project.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01590

FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary field offices and sheds.

1.2 USE OF FACILITIES

A. Existing and permanent facilities shall not be used for field offices or for storage.

PART 2 PRODUCTS

2.1 MATERIALS, EQUIPMENT, FURNISHINGS

A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.2 TEMPORARY FIELD OFFICES AND SHEDS

A. Construction
   1. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
   2. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove at completion of Work.
   3. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
   4. Exterior Materials: Weather resistant, finished in one color acceptable to Owner.
   5. Interior Materials in Offices: Sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.
   6. Lighting for Offices: 50 ft-C at desk top height, exterior lighting at entrance doors.
   7. Fire Extinguishers: Appropriate type fire extinguisher at each office and each storage area.
   8. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

B. Environmental Control
   1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfortable conditions. 70 degrees F heating and 72 degrees F cooling.
   2. Storage Spaces: Heating and ventilation as needed to maintain Products in accordance with Contract Documents; adequate lighting for maintenance and inspection of Products.

C. Contractor Office And Facilities
   1. Size: For Contractor's needs and to provide space for project meetings.
   2. Furnishings in Meeting Area: Conference table and chairs to seat at least 10 persons; racks and files for Contract Documents, submittals, and project record documents.
   3. Equipment: Six adjustable band protective helmets for visitors, one 10 inch outdoor weather thermometer.

D. Engineer's Office
   1. Contractor shall provide a separate trailer or a separate space in the Contractor's trailer for sole use of Engineer, with separate entrance door with new lock and two keys.
   2. Area: Minimum 160 sq ft, minimum dimension 8 ft for one office and common area.
   3. Windows: Minimum two, with minimum total area of 15 percent of floor area, with operable sash and insect screens.
   4. Minimum ten 110 volt duplex convenience outlets, at least one on each wall.
   5. Scanner / Printer Machine: Provide one (1) scanner / laser printer multi-function machine, Brother MFC-7240, or equal. Contractor shall provide service and supplies through duration of project.
   6. Furnishings:
      a. One 60" x 30" desk, double pedestal
      b. One drafting table, 36" x 72", with one equipment drawer and full width parallel straight edge.
      c. Plan rack with 12 hangers to hold working Drawings, shop drawings, and record documents.
      d. One standard four-drawer legal - size metal filling cabinet
      e. One swivel arm chair.
      f. One waste basket.
      g. One drafting table stool.
      h. Two tackboards, 36" x 30".
      i. First-aid kit.
      j. One refrigerator, 3 cu. Ft. minimum
   7. Environmental controls: Thermostatically controlled heating and cooling as specified above.

2.3 STORAGE AREAS AND SHEDS

A. Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01600.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fill and grade sites for temporary structures to provide drainage away from buildings.

B. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.

C. Parking: Contractor shall provide two parking spaces as specified in Section 01500 for use by the Engineer, connected to office by walk.

D. Employee Residential Occupancy: Not allowed on Owner's property.

E. Provide temporary services required for field offices as specified in Section 01500.

3.2 MAINTENANCE AND CLEANING

A. Contractor shall provide weekly janitorial services, cleaning, trash removal and maintenance for Engineer’s office, Contractor’s office and storage areas. Contractor shall maintain approach walks free of mud, water, and snow.

3.3 REMOVAL

A. At completion of Work, Contractor shall remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

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SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product delivery requirements.

C. Product storage and handling requirements.

D. Product options.

E. Product substitution procedures.

1.2 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide off-site storage and protection when site does not permit on-site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Architect/Engineer will consider requests for Substitutions only within 30 days after date established in Notice to Proceed.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.
   5. Will reimburse Owner for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
   1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
   2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
   3. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01650

STARTING OF SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Starting equipment and systems.

B. Operator training.

C. Plant start-up.

D. Testing, Adjusting and Balancing.

1.2 STARTING EQUIPMENT AND SYSTEMS

A. Startup: Systematic process of ensuring systems perform interactively according to design intent and Owner’s operational needs. Startup process encompasses and coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training, and verification of actual performance.

B. Provide a schedule for start-up for each new system or facility. Schedules shall conform to Section 01323 and shall provide sufficient detail for a logical sequence of tasks leading to start-up. Start-up schedule shall be submitted to Architect/Engineer 30 days prior to start-up.

C. Coordinate schedule for start-up of various equipment and systems.

D. Notify Engineer seven days prior to start-up of each item.

E. Conduct progress startup meetings throughout construction, to plan, scope, coordinate, schedule future activities and resolve problems.

F. Verify that all O&M manuals have been submitted and approved in accordance with Section 01730.

G. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions that may cause damage.

H. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

I. Verify wiring and support components for equipment are complete and tested.

J. Execute start-up under supervision of responsible manufacturer's representative in accordance with manufacturers' instructions.

K. Require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

L. Submit a written report in accordance with Section 01445 that equipment or system has been properly installed and is functioning correctly.

1.3 OPERATOR TRAINING

A. Operator training shall conform to the requirements of Section 01445.

B. Demonstrate operation and maintenance of equipment and products to Owner's personnel at least 14 days prior to start-up.

C. Demonstrate Project equipment and instruct in a classroom environment located at the treatment plant and instructed by a manufacturers' representative who is knowledgeable about the Project.

D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at designated location.

G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

H. The amount of time required for operator training on each item of equipment and system is that specified in individual sections.

1.4 LIFT STATION START-UP

A. Wastewater Start-up Period:
   1. The Wastewater Start-up Period shall not commence until:
      a. Manufacturer's Certificates of Proper Installation have been provided for all installed equipment.
      b. Pipeline pressure tests have been completed.
      c. Equipment has been lubricated in conformance with the manufacturer's recommendations.
      d. All functional testing has been completed.
      e. All performance testing has been completed, except for testing that the Engineer accepts to be performed during the Wastewater Start-up Period.
      f. The process instrumentation and control systems (all of Division 13 requirements) Operational Readiness Test has been substantially completed and documented.

g. All tests, adjustments, and settings have been performed on electrical equipment.
h. All operations and maintenance manuals have been approved by the Engineer.

2. Start-up of the new facilities with wastewater includes coordinated operation of the facilities by the Contractor, his subcontractors, Owner-operating personnel, and manufacturer's representatives for equipment items and systems.
3. The Contractor shall provide the following services.
   a. Provide the coordinated services of all subcontractors and equipment suppliers to correct any and all observed and experienced deficiencies in the specified services completed or yet to be performed.
   b. Complete testing on specified items, such as pumps, and coordinate with the Owner's operation of such equipment.
   c. Complete the instrumentation system functional acceptance test.
   d. Provide the services of a project superintendent to manage any contract change orders during start-up.
4. The Contractor shall designate and provide one or more persons to be responsible for coordinating and expediting his start-up duties. The person or persons shall be present during all prestart-up meetings and shall be available to the Owner's personnel at all times during the wastewater start-up period.
5. Where start-up services are called for in the Specifications, the Contractor shall supply and coordinate the specified manufacturers' services for the start-up period.
6. The Contractor shall conduct performance tests on all equipment, systems, and subsystems not previously tested and approved by the Engineer.
7. The Contractor shall be responsible for adjustments, repairs, and corrections of specified work.
8. The Owner will provide and pay for the necessary electrical service used during the pumping start-up and operation periods.
9. Following the successful start-up of lift station facilities on wastewater, the Owner will assume full responsibilities for all operations, maintenance and process adjustments. The Contractor, subcontractors, and equipment manufacturer(s) shall only be responsible for specified warranty work, uncompleted work and remaining training services.
10. Provide skilled trades crew for performance of work as directed by the Engineer during startup. This work is in addition to the Contractor’s specified responsibilities, and will be paid for from the Allowances. Contractor shall have prior approval from the Engineer prior to performing work under this allowance.
11. Successful completion of Startup is required prior to Substantial Completion.

1.5 TESTING, ADJUSTING AND BALANCING

A. Contractor will appoint and employ services of independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services.

B. Independent firm will perform services specified in Division 15.

C. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01660

WATER TEST FOR CONCRETE TANKS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section includes leakage testing for all new liquid holding concrete tanks.

1.2 TEST CONDITIONS

A. Conduct test prior to backfilling and prior to coating tank.

B. Test shall not be started prior to concrete obtaining its 28 day strength.

C. Water for testing: City water (W1) and / or non-potable water (W2) is available for use by the Contractor. Contractor shall pay costs of W1 and W2 water directly to the Owner. Contractor shall provide temporary pumping and piping facilities to transport water as required. Disposal of water used in testing shall be the Contractor's responsibility.

1.3 TEST CRITERION

A. Water Leakage Tests - All Water-Holding Structures:

1. All new water-holding structures shall be subjected to leakage tests after the concrete has been cured and obtained its design strength, and before backfill, brick facing, or other work that will cover the exposed faces of the walls is begun.
2. All basins to be subjected to leakage tests shall be filled with water to the normal liquid level line. After the basin has been kept full for 48 hours, it will be assumed for the purposes of the test that the absorption of moisture by the concrete in the basin is complete. All valves and gates to the structure shall then be closed and the change in water surface measured for a 24-hour period.
3. During the test period, all exposed portions of the structure shall be examined and all visible leaks or damp spots shall be marked; such leaks or damp spots shall be later patched or corrected in a manner acceptable to the Engineer. If the drop in water surface in the 24-hour period exceeds 1/10 of 1 percent of the normal volume of liquid contained in the water-holding structure, after accounting for evaporation and precipitation in open basins, the leakage shall be considered excessive. Evaporation shall be determined by floating an evaporation pan in the structure during the test period.
4. If the leakage is excessive, the basin shall be drained, all leaks previously marked shall be patched, and the necessary repairs made. The Contractor's method of repair shall be subject to the requirements of these Specifications and submitted for review by the Engineer.
5. The basin shall then be refilled and again tested for leakage. This process shall be continued until the drop in water surface in a 24-hour period with the basin full is less than 1/10 of 1 percent of the volume of liquid held in the basin. All repairs of faulty workmanship and materials, as well as additional testing, shall

be made by the Contractor in an acceptable manner at no additional cost to the Owner. Both the correction for excessive leakage and the removal of the damp or wet spots on walls shall be required to pass the leakage test.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 TEST PROCEDURE

A. Fill tank to intended operating level:
   1. Compute volume of tank to this level.

B. Measure water elevation on each tank wall at four equidistant points and average readings:
   1. Provide stilling wells at each measuring point to dampen wave action.
   2. Make measurements to 0.005 feet.

C. At end of test period measure water elevation to determine loss or gain volumetrically:
   1. Correct for evaporation and rainfall.

D. Tanks initially passing leakage test shall have all visible leaks repaired prior to coating.

E. Perform following to tanks not meeting allowable leakage:
   1. Locate leaks.
   2. Drain tank and repair leaks.
   3. Submit methodology and proposed materials for repairing of leaks to Engineer for review. Engineer will determine acceptability of proposed methods and materials.
   4. Repair cracks.
   5. Refill and retest tank.
   6. Repeat repairing and testing procedures as many times as necessary to meet allowable leakage.

F. Water leakage testing shall be performed on the following structures:
   1. Lift Station wet well.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Adjusting.

D. Project record documents.

E. Operation and maintenance data.

F. Warranties.

G. Spare parts and maintenance materials.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Provide submittals to Engineer that are required by governing or other authorities.

C. Submit final Application for Payment as specified in the GENERAL CONDITIONS identifying total adjusted Contract Price, previous payments, and amount remaining due. Included with the final Application for payment shall be the following written certifications:
   1. Final waiver of liens from Contractor, all subcontractors and all material and equipment suppliers.
   2. Contractor's affidavit of release of liens.
   3. Consent of surety for final payment.
   4. Contractor's affidavit of payment.
   5. Affidavit of compliance with wage rate determination in accordance with Division 0.

1.3 FINAL CLEANING

A. Final cleaning as specified in Section 01710 - Cleaning.

1.4 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.5 PROJECT RECORD DOCUMENTS

A. Project Record Documents are to be submitted as specified in Section 01720 - Project Record Documents.

1.6 OPERATION AND MAINTENANCE DATA

A. Operation and maintenance data are to be submitted as specified in Section 01730 - Operation and Maintenance Data.

1.7 WARRANTIES AND BONDS

A. Provide notarized copies.

B. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in three ring binder with durable plastic cover.

D. Submit to Engineer for approval prior to final Application for Payment.

E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

B. Deliver to Project site and place in location as directed; obtain receipt prior to final payment. Fill out and submit to the Owner the attached Spare Parts Transfer Form for each parcel of spare parts delivered.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

Spare Parts Transfer Form

Owner: _____ Contract: _____
Project: _____ Contractor: _____

Spec. Section	Quantity	Item Description	Part No.

The above listed Spare Parts submitted by _____
(Contractor)

under Contract _____, have been inspected and inventoried, and are hereby accepted, subject to all contract provisions, by the _____
(Owner)

Signature: _____
(Owner Representative)

Title: _____

CC: Engineer
Contractor

Date: _____

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SECTION 01710

CLEANING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of existing facilities to be modified.

B. Cleaning during construction.

C. Dust control.

D. Final cleaning.

1.2 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 PRODUCTS

2.1 MATERIALS

A. Use only those cleaning materials that will not create hazards to property or damage surfaces of material to be cleaned.

PART 3 EXECUTION

3.1 CLEANING OF EXISTING FACILITIES

A. Owner will empty tank contents and provide a general wash to remove wastewater residues and solids from all tank walls, tank floors, and piping prior to Contractor commencing work. Contractor shall provide a minimum of 10 days' notice to Owner prior to scheduled construction date. Structures requiring cleaning prior to demolition include the following:
   1. Existing N. Chicago Lift Station Wet Well.
   2. Existing manholes shown to be removed on Drawing 20-R-1.
   3. Existing force mains shown to be abandoned on Drawing 20-R-1.

B. Contractor to provide additional cleaning as required for proper construction.

C. Flush and drain all piping to be modified prior to construction.

D. Dispose of all solid waste in an approved landfill.

3.2 DURING CONSTRUCTION

A. Execute periodic cleaning to keep Work, site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris resulting from construction operations.

B. Provide on-site containers for collection and removal of waste materials, debris, and rubbish in accordance with applicable regulations. Remove weekly and dispose of off-site.

C. Thoroughly clean all spilled dirt, gravel, or other foreign material caused by the construction operations from all streets and roads at the conclusion of each day's operation.

D. Provide daily cleaning of facilities in use by the Owner when construction dust, mud or debris interfere with the Owner’s operations.

E. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

F. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

3.3 DUST CONTROL

A. Clean interior space prior to start of finish painting and continue cleaning on as-needed basis until painting is completed.

B. Schedule operations so dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.

C. Give all roads and haul roads used in the construction area an approved dust-preventive treatment or daily watering when requested by the Engineer to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

3.4 FINAL CLEANING

A. Employ skilled workers for final cleaning.

B. Execute final cleaning prior to final inspection.

C. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Clean all interior walls, ceilings, floors, cabinets, and furniture.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Wash and shine glazing and mirrors.

G. Polish glossy surfaces to clear shine.

H. Ventilating Systems:
   1. Clean permanent filters and replace disposable filters if units were operated during construction.
   2. Clean ducts, blowers, and coils if units were operated without filters during construction.

I. Electrical Systems:
   1. Leave electrical equipment rooms broom clean.
   2. Clean interior of panel cabinets, pull boxes, and other equipment enclosures.
   3. Wash and wipe clean lighting fixtures, lamps, and other electrical equipment that may have become soiled during installation.
   4. Touch-up paint and repaint, if deterioration is extensive, electrical items delivered to job with finish coat of paint.

J. Clean debris from roofs, gutters, down spouts, and drainage systems.

K. Clean site; sweep paved areas, rake clean landscaped surfaces.

L. Remove waste and surplus materials, rubbish and construction from the site.

END OF SECTION

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SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Maintenance of Documents and Samples.

B. Record Documents.

C. Submittals.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Maintain at site, one copy of the following Record Documents:
1. Drawings.
2. Specifications.
3. Addenda.
4. Change orders and other modifications to Contract.
5. Field orders, written instructions, or clarifications.
6. Approved submittals.
7. Field test records.
8. Construction photographs.
9. All associated permits.
10. Certificates of inspection and approvals.

B. Store documents and samples in Contractor's field office on-site apart from documents used for construction:
1. Provide files and racks for storage of documents.
2. Provide secure storage space for storage of samples.

C. Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

D. Make documents and samples available at all times for inspection by Engineer.

E. Failure to properly maintain record documents may be reason to delay a portion of progress payments until records comply with Contract Documents.

1.3 RECORD DOCUMENTS

A. Maintain record set of drawings and specifications legibly changed to transfer approved modifications in completed Work that differ from Contract Documents.

B. Label each document "Project Record" in neat, large printed letters.

C. Record information concurrently with construction progress.

1. Do not conceal any work until required information is recorded.
2. Record changes made by Written Amendment, Field Order, Change Order, or Work Directive Change.

D. Specifications: Legibly mark and record at each section description of actual Products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

E. Drawings:
1. General:
a. All finished manhole rim and invert elevations, as well as sanitary and storm sewer invert elevations in structures and outfalls.
b. Depths of various elements of foundation in relation to finish first floor datum.
c. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
d. Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
e. Field changes.
f. Details not on original Drawings.
g. Location and identification of exposed interior piping.
2. Electrical:
a. Horizontal and vertical locations and size of underground cable, conduit, and duct runs dimensioned from established building lines.
b. Plan location and size of interior concealed and exposed feeders.
c. Size and location of access panels.
d. Departures from original drawings and electrical work revisions.

1.4 SUBMITTALS

A. At Final Completion, deliver a complete electronic set of submittal documents to Engineer.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

A. Not used.

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Format and content of manuals.

B. Equipment data form.

1.2 QUALITY ASSURANCE

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.3 SUBMITTALS

A. Submit a copy for review within 60 days after time Contractor receives approved Shop Drawings for equipment/systems from Engineer.

B. Provide two hard copies of the final approved O&M manuals and one electronic version as described herein.

C. Progress payments for equipment delivered, stored, or installed under these Contract Documents will not be made beyond 50% of the scheduled value until copies of the O&M data are delivered to and approved by Engineer. Progress payments for control systems packaged with equipment will not be made beyond 50% of the scheduled value until O&M data revisions are incorporated into equipment and control system manuals delivered and approved by Engineer.

D. Engineer's review and acceptance of operation and maintenance manuals will be only for conformance with requirements of this section, for form of submittal and organization of data and completeness of information provided, but not for technical content or coordination between individual suppliers of equipment or system(s).

1.4 HARD COPY FORMAT

A. Prepare data in the form of an instructional manual.

B. Binders: Commercial quality, 8-1/2 x 11 inch three-ring binders with hardback, cleanable, plastic covers; two inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

C. Cover: Identify each binder on the cover and spine with typed or printed title OPERATION AND MAINTENANCE MANUAL; list title of Project and subject matter of contents.

D. Provide a Cover Page that provides the following information:
   1. Title of project.
   2. Specification number and title.
   3. Manufacturer.
   4. General Contractor.
   5. Subcontractor.
   6. Supplier.

E. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

F. Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment. All tabs shall be legible with permanent smudge resistant lettering.

G. Text: Manufacturer's printed data, or typewritten data on 20 pound paper. Manufacturer's printed data must be originals or copies of good quality and clearly legible. Non-legible copies are not acceptable and will be rejected.

H. Drawings 11 X 17 inch or smaller: Provide with reinforced punched binder tab. Bind in with text; fold 11 x 17 inch drawings to size of text pages.

I. Drawings larger than 11 X 17 inch: Provide clear plastic holder the size of the test pages, punched and bound in binder with the enclosed folded drawing.

1.5 ELECTRONIC COPY FORMAT

A. Contractor is responsible for producing an electronic version of the Equipment Operations and Maintenance (O&M) Manuals Manual. Contractor shall obtain all copyright permissions associated with conversion of O&M manual information into electronic format.

B. The filename for the Equipment O&M Manual submittal will include the specification section number and specification section title. No one file shall be larger than 10 MB.

C. The number of files shall be kept to a minimum. Equipment O&M Manuals that span more than one file shall have the final Bookmark "Return to Table of Contents" which shall take the User to the first file on the Equipment O&M Manual.

D. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document form (*.PDF). The entire manual may be converted to PDF via scanning or other method of conversion. Drawings or other graphics must be converted to PDF format and made part of the PDF document. The resolution of all scanned images shall be a minimum of 300 dpi unless otherwise requested by Engineer. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 8 or higher). This results in a clear image and provides for optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. All submittals must be indexed with the Adobe Catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems

when transferring files. Successful searches for words or strings in the PDF document shall demonstrate proof of OCR.

E. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.

F. Bookmarks shall be created in the navigation frame for each entry in the Table of Contents. Three levels deep is usually enough (i.e., "Chapter", "Section", "Subsection"); however, complex submittals like instrumentation and electrical may be required at the discretion of Engineer. When setting bookmarks for Chapter level heading, the page shall be displayed at Full Page. Section and Subsection level heading pages shall be displayed as a magnified view. Bookmarks shall be displayed as subordinate to other bookmarks in their hierarchy set so that only the Chapter level headings are displayed.

G. Files shall be delivered without Security features activated. Password protected files will be unacceptable.

H. The opening view for PDF files shall be set as follows:
1. Initial View: Bookmarks and Page
2. Magnification: Fit In Window
3. Page Layout: Single Page

I. The file shall open to the cover page of the Equipment O&M Manual with bookmarks to the left. The first bookmark shall be the name of Equipment O&M Manual.

J. The submittal shall be delivered on CD after all Equipment O&M Manuals have been received and approved. Each CD shall be labeled, at a minimum, as follows, including: 1) CD-ROM disks, 2) jewel cases, and 3) hard copies.
1. Manufacturer name, point of contact, telephone number, facsimile number, and e-mail address as appropriate
2. Equipment name and/or O&M title spelled out in complete words
   a. Example: “Operations and Maintenance Manual - Horizontal Centrifugal Nonclog Pumps”
3. Specifications section number
4. Project name
5. Date and File Name: Example "12-20-15", "19876_01.pdf"

K. Contractor shall reprocess any portion of the document that does not view or print to Owner's satisfaction.

1.6 CONTENTS, EACH VOLUME

A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information. Clearly mark the selected product by use of arrows, underlines, or circles where more than one product is shown. Use of highlighters to identify the selected product is unacceptable.

1.7 MANUAL FOR MATERIALS AND FINISHES

A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional Requirements: As specified in individual product specification Sections.

E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.8 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, complete nomenclature and commercial number of replaceable parts, complete nameplate data, and P&ID numbers as set forth in the Drawings.

B. Completed equipment data form included with this section. Manufacturer's standard form will not be acceptable.

C. Operating Procedures:
1. Start-up, break-in, and routine normal operating instructions and sequences.
2. Regulation, control, stopping, shut-down, and emergency instructions.
3. Safety instructions.
4. Summer, winter, and any special operating instructions.

D. Maintenance Requirements:
1. Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
2. Provide servicing and lubrication schedule, and list of lubricants required.
3. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
4. Provide list of original manufacturer's spare parts, predicted life, current prices, and recommended quantities to be maintained in storage.

E. Electrical Data:
   1. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.
   2. Include color-coded wiring diagrams as installed.

F. Provide control diagrams by controls manufacturer as installed. These shall be ladder diagrams, instrument loop diagrams, and electrical schematics as appropriate. Include sequence of operation by controls manufacturer.

G. Provide Contractor's coordination drawings, with color-coded piping diagrams as installed.

H. Provide charts of valve tag numbers, with location and function of each valve, keyed to P&ID numbers as set forth in the Drawings.

I. Bill of material.

J. Include test and balancing reports as specified in Division 15.

K. Additional Requirements: As specified in individual product specification Sections.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

EQUIPMENT DATA FORM (Page 1 of 3)

PROJECT NAME _____

CONTRACT NO. _____

CONTRACTOR _____

EQUIPMENT NO. _____

DESCRIPTION _____

LOCATION _____

MANUFACTURER _____

PURCHASED FROM _____ PURCHASE DATE _____

VENDOR ORDER NO. _____ PURCHASE PRICE _____

LOCAL SUPPLIER _____ PHONE _____

ADDRESS _____

MODEL NO. _____ SHIPPING WT/UNIT _____

NO. OF UNITS _____ SERIAL NOS. _____

NAMEPLATE DATA

ELECTRIC MOTOR	PUMP/HVAC UNIT	DRIVE/REDUCER	OTHER (I&C)
MANUFACTURER:	MANUFACTURER:	MANUFACTURER:	MANUFACTURER:
_____	_____	_____	_____
TYPE: []AC []DC	TYPE_____	TYPE: []GEAR []V-BELT []CHAIN []VARIDRIVE	TYPE_____
HP_____	SIZE_____		SIZE_____
RPM_____	CAPACITY_____		CAPACITY_____
VOLTAGE_____	PRESSURE_____	SERVICE FACTOR_____	RANGE_____
AMPERAGE_____	ROTATION_____	RATIO_____	
PHASE_____	IMPELLER: SIZE_____		
FRAME_____	MATERIAL_____		

EQUIPMENT DATA FORM (Page 2 of 3)

MAINTENANCE SUMMARY

EQUIPMENT NO. _____

DESCRIPTION _____

MAINTENANCE OPERATION	FREQUENCY
List briefly each maintenance operation required and refer to specific information in Manufacturer's Maintenance Manual, if applicable. Refer by symbol to "Lubricant List" for Lubrication Operation.	List required frequency of each maintenance operation.
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

LUBRICANT/RECOMMENDED SPARE PARTS LIST

EQUIPMENT NO. _____

DESCRIPTION _____

LUBRICANT LIST

LUBRICANT REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED AND MANUFACTURER
List symbol in "maintenance operation"	List general lubricant type	List specific lubricant name, viscosity and manufacturer
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

RECOMMENDED SPARE PARTS LIST

PART NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

NOTE: Identify parts provided by this Contract with two asterisks.

ADDITIONAL DATA AND REMARKS

_____

_____

_____

SECTION 02221

BUILDING DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Asbestos, lead, and universal waste removal.
   2. Demolishing designated structures.
   3. Demolishing designated foundations.
   4. Demolishing designated slabs-on-grade.
   5. Disconnecting and capping designated utilities.
   6. Filling designated underground tanks.
   7. Removing designated items for reuse and Owner's retention.
   8. Protecting items designated to remain.
   9. Removing demolished materials.

1.2 SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for submittals.

B. Demolition Schedule: Indicate overall schedule, description of demolition removal procedures and interruptions required for utility and building services for review and approval by Owner.

C. Shop Drawings: Indicate location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, subsurface obstructions, and limits of buried structure removal.

1.4 QUALITY ASSURANCE

A. Obtain required permits from authorities having jurisdiction.
   1. Submit a Notification for Demolition and/or Renovation (Form 4500-113) to WDNR at least 10 days prior to commencing demolition work.

B. Conform to applicable code for demolition work, safety of adjacent structures, dust control, products requiring electrical disconnection and re-connection, and disposal of demolition wastes.

C. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

1.5 SEQUENCING

A. Section 01100 - Summary of Work: Requirements for sequencing.

B. All asbestos and hazardous waste removal activities must be completed prior to commencing demolition work.

1.6 SCHEDULING

A. Section 01323 - Network Analysis Schedules: Requirements for scheduling.

B. Schedule Work to precede site excavation work and new construction.

C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation and adjoining property owners.

D. Coordination:
   1. Perform demolition work in a manner which does not interfere with the Owner's operations.
   2. Coordinate demolition work so that new construction may proceed without undue delay.

1.7 ASBESTOS, LEAD, AND UNIVERSAL WASTE REMOVAL

A. Asbestos:
   1. Asbestos containing materials are present in the existing Lift Station; see attached Pre-Demolition Inspection Report for description of testing performed on materials.
   2. Provide personnel certified to conduct and supervise asbestos testing and removal activities.
   3. Reused and salvaged equipment shall be removed from the existing Lift Station prior to asbestos removal activities.
   4. Comply with federal and state regulations covering the testing, removal and disposal of asbestos-containing materials.
   5. Asbestos removal activities shall be paid under the Asbestos, Lead, and Universal Waste Removal Allowance.

B. Lead:
   1. Materials containing lead-based paint are present in the existing Lift Station; see attached Pre-demolition Inspection Report for description of materials.
   2. Provide personnel certified to conduct and supervise lead-based paint removal activities.
   3. Comply with federal and state regulations covering the removal and disposal of lead based-containing materials.
   4. Lead-based paint removal activities shall be paid under the Asbestos, Lead and Universal Waste Removal Allowance

C. Universal Waste:
   1. Materials containing universal wastes are present in the existing Lift Station; see attached Pre-demolition Inspection Report for description of materials.

2. Provide personnel certified to conduct and supervise waste removal and disposal activities.
3. Comply with federal and state regulations covering the removal and disposal of waste materials.
4. Universal waste removal activities shall be paid under the Asbestos, Lead and Universal Waste Removal Allowance

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Fill Material: Specified in Section 02320.

B. Force Main Abandonment: See Drawings for material requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Make arrangements with building owners and occupants to survey interior and exterior of existing buildings.

B. Survey and record condition of existing facilities to remain in-place that may be affected by the demolition work. After work is completed, restore facilities to original condition at no additional cost to the Owner.

3.2 PREPARATION

A. Obtain written release from Owner before beginning demolition for each structure.

B. Notify affected utility companies before starting work to permit them to disconnect, remove, or relocate services at existing facilities. Comply with their requirements.

C. Reroute or shut off electrical, HVAC, process, and plumbing services outside the area of demolition.

D. Mark location and termination of utilities.

E. Salvage items specified for reuse in the Work or specified to be delivered to the Owner.

F. Erect and maintain temporary barriers and security devices around perimeter of demolition site, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.

G. Drain or pump out basins to be demolished or abandoned. Dispose of liquid wastes properly.

H. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.

I. Schedule completion of asbestos removal prior to demolition.

3.3 DEMOLITION REQUIREMENTS

A. Use of explosives is not permitted.

B. Conduct demolition to minimize interference with adjacent structures and plant operations.

C. Do not close or obstruct roadways, sidewalks, or hydrants without permits.

D. Provide appropriate temporary signage including signage for exit or building egress.

E. Do not close or obstruct building egress path.

F. Protection:
1. Structural stability of structures adjacent to or affected by demolition work shall be the Contractor's responsibility.
2. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as required.
3. Maintain in service and protect from damage existing facilities, utilities, and equipment to remain.
4. Existing landscaping materials, trees, appurtenances, structures, and utilities indicated to remain.
5. Erect and maintain weatherproof closures for exterior openings.

G. Cease operations immediately when adjacent structures appear to be in danger. Notify Architect/Engineer. Do not resume operations until directed.

H. Conduct operations with minimum interference to public or private accesses. Maintain egress and access at all times.

I. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property.

J. Sprinkle Work with water to minimize dust. Provide hoses and water connections required for this purpose.

3.4 DEMOLITION

A. Conduct demolition work as shown on the Drawings.

B. Disconnect, remove and cap designated utilities within demolition areas. Remove utilities and piping to limits shown on the Drawings. Plug or seal permanently with steel cap, concrete plug, or other approved method. Remove abandoned utilities and underground piping within influence zone of proposed piping and structures.

C. Remove foundation walls and footings to minimum of two feet below finished grade within area of new construction unless shown otherwise on the Drawings.

D. Remove concrete slabs-on-grade.

E. Empty underground tanks located within demolition area.

F. Fill underground tanks with fill material as specified in Section 02320. Disconnect and remove piping.

G. Carefully remove building components indicated to be reused.
   1. Disassemble components as required to permit removal.
   2. Package small and loose parts to avoid loss.
   3. Mark components and packaged parts to permit reinstallation.
   4. Store components, protected from construction operations, until reinstalled.

H. Backfill areas excavated, open pits, and holes resulting from demolition, in accordance with Section 02320.

I. Rough grade and compact areas affected by demolition to maintain site grades and contours as shown on the Drawings.

J. Continuously clean up and remove demolished materials from site. Do not allow materials to accumulate on site.

K. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.

L. Remove temporary Work.

3.5 SALVAGE

A. Salvage materials indicated on the Drawings.The following existing items shall be salvaged from the existing lift station and delivered to the Owner:
   1. Three (3) variable speed drives.
   2. Three (3) Raw Sewage pumps, motors, and bases
   3. Trolley and electric hoist.
   4. FRP door and frame on south side of station.

B. Owner reserves the right to select other items for salvage during construction.

C. Owner has first right to building components, piping, valves, wire and equipment being removed. Coordinate with Owner to identify items to be removed and delivered to Owner

D. Tag components and equipment Owner designates for salvage. Protect designated salvage items from demolition operations until items can be removed. Package small and loose parts to avoid loss.

E. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

F. Deliver salvaged materials to the Owner's designated storage location at the WWTF site on 5th Avenue.

G. Remove and dispose of all piping, valves and equipment from site not required by Owner.

3.6 DISPOSAL

A. All waste materials from demolition work shall be removed from the site and disposed of in accordance with all applicable federal and state laws and regulations.

END OF SECTION

PRE-DEMOLITION INSPECTION REPORT
Job Site:

North Chicago Lift Station
1430 North Chicago Avenue
South Milwaukee, Wisconsin

For:

Applied Technologies, Inc
Attn: Kathleen Hassing
16815 West Wisconsin Avenue
Brookfield, WI 53005

KPH Project No.: 17-400-030

Dean Jacobsen
Asbestos Inspector No. AII – 14370
Lead Risk Assessor No. LRA – 14370

Prepared by:

KPH Environmental Corp.
1237 West Bruce Street
Milwaukee, Wisconsin 53204

February 2017

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I. INTRODUCTION

KPH Environmental Corp., (KPH) was retained by Applied Technologies, Inc., to conduct a pre-demolition inspection at the North Chicago Lift Station, 1430 North Chicago Avenue, South Milwaukee, Wisconsin for the following:

- Suspect asbestos containing materials
- Suspect lead based paint
- Universal wastes such as light fixture ballasts, mercury containing light bulbs, mercury containing switches, manometers, chlorofluorocarbons, PCB materials, and other equipment.

Applied Technologies, Inc., authorized KPH to conduct a pre-demolition inspection and to analyze samples collected during the inspection. The inspection of the North Chicago Lift Station, South Milwaukee, Wisconsin, was conducted on February 1, 2017, to cover the items listed above. The inspection was conducted by Dean Jacobsen, Wisconsin Asbestos Inspector License No. AII – 14370 and Wisconsin Lead Risk Assessor No. LRA – 14370. Additional information on the inspection and results are contained in the following sections.

II. ASEBSTOS INSPECTION

A. Methods

This asbestos inspection included a visual determination as to the extent of visible and accessible suspect materials in the building, sampling and documentation of these suspect materials, and quantification of observable and accessible positive materials existing within the spaces.

Bulk sampling involves inspecting all or part of a building (depending on the project scope) and identifying suspect asbestos containing materials. According to the USEPA, this includes all materials except wood, metal, and glass. After suspect materials are identified, the inspector divides the building into homogeneous areas. Homogeneous areas contain materials that are alike in color, composition, age of installation, and any other aspect. If any differences are identified during the inspection, a separate homogeneous area is established. The inspector then uses USEPA sampling protocols to collect bulk samples based upon the type of material and quantity of material in the homogeneous area. Bulk samples are placed into resealable containers and sent to a laboratory certified under the National Voluntary Laboratory Accreditation program (NVLAP) for analysis. Destructive sampling was not conducted where it would have adversely impacted suspect asbestos containing materials, such as plaster, to avoid damage and building contamination.

The results of the survey integrated with the Polarized Light Microscopy with Dispersion Staining (PLM/DS) analysis of bulk samples taken are outlined in this document.

B. List of Suspect Asbestos Containing Materials

The following types of suspect materials were inspected to determine if asbestos containing materials were present within the building as required by US EPA NESHAP regulation 40 CFR 61 Subpart M and NR 447 of the Wisconsin Administrative Code:

- Asphalt roofing
- Tar paper
- Caulk
- Brick/mortar

- Ceiling tile
- Transite panel
- Concrete
- Concrete block/mortar

A listing of specific homogeneous materials and homogeneous material codes are in the Samples and Results section following the results table.

C. The Laboratory

Samples were analyzed at Amerisci of Midlothian, Virginia for total asbestos content by volume using EPA Method 600/M4/82/020, 600/R-93/116. Analysis is performed by using the bulk samples for visual observation and slide preparation(s) for microscopical examination and identification. The slides are analyzed for asbestos (chrysotile, amosite, crodcidolite, anthophyllite, and actinolite/ tremolite), fibrous non asbestos constituents (mineral wool, paper, etc.), and nonfibrous constituents. Asbestos is identified by refractive indices (obtained by using dispersion staining), morphology, color, pleochroism, birefringence, extinction characteristics, and signs of elongation. The same characteristics are used to identify the non asbestos constituents.

The microscopist visually estimates relative amounts of each constituent using a stereoscope if necessary. The test results are based on a visual determination of relative volume of the bulk sample components. The results are valid only for the item tested. Where the first sample of a homogeneous material contained more than 1% asbestos, the subsequent samples of that material were not analyzed. A point count analysis is performed for samples where the polarized light microscopy result is close to 1%. The point count is a more accurate fiber counting method and takes precedence over polarized light microscopy result.

Current regulations state asbestos containing materials (ACM) means material containing more than 1% asbestos as determined using the method specified in Appendix E, Subpart E, 40 CFR Part 763 Section I, Polarized Light Microscopy. Bold values indicate that the material contains more than 1% asbestos.

Refer to 29 CFR 1926.1101 (Construction) and 29 CFR 1910.1001 (General Industry) for specific OSHA asbestos safety requirements.

D. Samples and Results

The following are the laboratory results. The laboratory report is in Appendix A.

Sample #	Location and Description	Lab Result	Homogeneous Code
1A-NS	Roof – east side top layer – asphalt shingle	Negative	MRS
1B-NS	Roof – north side top layer – asphalt shingle	Negative	MRS
1C-NS	Roof – west side top layer – asphalt shingle	Negative	MRS
2A-NS	Roof – east side bottom layer – tar paper	Negative	MPT
2B-NS	Roof – north side bottom layer – tar paper	Negative	MPT
2C-NS	Roof – west side bottom layer – tar paper	Negative	MPT
3A-NS	Exterior – on north windows – brown caulk	Positive 2% Chrysotile	MCLKn
3A-NS	Point Count Result	Trace 0.39% Chrysotile	MCLKn
4A-NSa	Exterior – northeast corner wall – brick	Negative	MBR
4A-NSb	Exterior – northeast corner wall – mortar	Negative	MBR

Sample #	Location and Description	Lab Result	Homogeneous Code
4B-NSa	Exterior – northwest corner wall – brick	Negative	MBR
4B-NSb	Exterior – northwest corner wall – mortar	Negative	MBR
4C-NSa	Exterior – southwest corner wall – brick	Negative	MBR
4C-NSb	Exterior – southwest corner wall – mortar	Negative	MBR
5A-NS	Exterior – around west wall metal grill – white caulk	Negative	MCLKw
6A-NS	Exterior – around east side boarded window – red caulk	Negative	MCLKr
7A-NS	Interior – north room – 2' x 2' ceiling tile	Negative	MSCT22
8A-NS	**Interior – south room – ceiling – transite panel**	**Positive 15% Chrysotile**	**MTP**
9A-NS	Interior – north pit floor – concrete	Negative	MCON
9B-NS	Interior – north room floor – concrete	Negative	MCON
9C-NS	Interior – south pit entry floor – concrete	Negative	MCON
10A-NSa	Interior – north room – south wall – brick #2	Negative	MBR2
10A-NSb	Interior – north room – south wall – mortar #2	Negative	MBR2
10B-NSa	Interior – north room – east wall – brick #2	Negative	MBR2
10B-NSb	Interior – north room – east wall – mortar #2	Negative	MBR2
10C-NSa	Interior – south room – east wall – brick #2	Negative	MBR2
10C-NSb	Interior – south room – east wall – mortar #2	Negative	MBR2
11A-NS	Interior – south room – around west wall grill – gray caulk	Negative	MCLKy
12A-NS	Interior – south room – east wall – concrete block/mortar	Negative	MCB

Homogeneous Material Codes

MRS	Asphalt shingle
MPT	Tar Paper
MCLKn	Brown Caulk
MCLKw	White Caulk
MCLKr	Red Caulk
MCLKy	Gray Caulk
MCTMy	Gray Ceramic Tile
MBR	Brick/Mortar
MBR2	Brick/Mortar #2
MSCT22	2' x 2' Ceiling Tile
MTP	Transite Panel
MCON	Concrete
MCB	Concrete Block/Mortar

E. Asbestos Locations and Quantities

The following asbestos containing material sampled was found to contain >1% asbestos by the PLM bulk asbestos laboratory method and is by definition an asbestos containing material:

Material	Homogeneous Code	Location	Approximate Quantity	Condition
Transite Panel	MTP	Interior South Room & South Pit Entry Ceilings – Nailed on	280 SF	Category II Non-Friable

Transite panel is nailed on to wood ceiling joists. It is a category II non-friable material and must be removed by a Wisconsin certified asbestos abatement contractor prior to demolition since it is likely to become crumbled, pulverized or reduced to powder during demolition.

KPH recommends that the engine in the interior South Room be removed from the building prior to abatement of the asbestos containing ceiling.

III. LEAD PAINT INSPECTION

A. Methods

A lead based paint inspection and sampling are recommended for building materials that may contain surfaces painted before 1978. The inspection determines if lead based paint is present in the building, the location(s) of lead containing surfaces, and the amount of lead in the paint. If the surfaces will be disturbed or demolished, workers can then prepare proper safety measures to reduce exposure to lead containing dust. In addition, the Wisconsin Department of Natural Resources requires determination of lead based paint prior to disposal or recycling of building materials (Concrete Recycling and Disposal Fact Sheet WA-605 2004).

The inspection and sampling testing at the North Chicago Lift Station, 1430 North Chicago Avenue, South Milwaukee, Wisconsin, took place on February 1, 2017. A room by room inspection was conducted, noting the location, substrate, and color of exterior and interior painted surfaces. Representative samples of paint were collected from painted surfaces representing different paint colors and substrates.

The Wisconsin Administrative Code (DHS 163) defines lead-based paint as having a surface concentration of lead that is more than 0.5% of lead per weight of a paint chip sample.

The results of the analysis was classified as follows:

Positive: Any result above the DHS 163 Standard of 0.5% lead.

Negative: Any result below the DHS 163 Standard of 0.5% lead.

The inspection protocol in KPHs Building Inspection Standard Operating Procedures was used.

B. Component Testing Results

In an effort to develop a painting history of the building, specific component types were tested for the presence of lead based paint. Reference Test Results of Components below-Bold values indicate locations where results are above the 0.5% DHS Standard. The laboratory report is in Appendix B.

Interior: North Chicago Lift Station, South Milwaukee, Wisconsin

- Painted surfaces were observed in all rooms, including most walls and floors. **Lead was not detected above 0.5% on any interior surface.**

Exterior: North Chicago Lift Station, South Milwaukee, Wisconsin

- **Painted surfaces were observed in the exterior brick wall and concrete ledges. Lead was detected above 0.5% on the brown paint, which is on the brick walls and concrete ledges.**

The following are the laboratory results. The laboratory report is in Appendix B.

Paint Testing Results						
Sample	**Room**	**Component & Feature**	**Substrate**	**Color**	**PbC (%)**	**Result**
1L-NS	**Exterior**	**Wall**	**Brick**	**Brown**	**1.5**	**Positive**
2L-NS	North Pit	Floor	Concrete	Gray	0.012	Negative
3L-NS	North Pit	Wall	Concrete	Gray	0.020	Negative
4L-NS	North Pit	Stair	Metal	Gray	0.019	Negative
5L-NS	North Pit	Pipes	Metal	Gray	<0.0034	Negative
6L-NS	North Room	Floor	Concrete	Tan	0.0089	Negative
7L-NS	North Room	Wall	Brick	Tan	<0.0049	Negative
8L-NS	North Pit	Wall	Concrete	Tan	0.031	Negative
9L-NS	South Pit	Wall	Concrete	Beige	<0.0035	Negative
10L-NS	South Pit	Stair	Metal	Yellow	0.075	Negative

Where lead based paint is known or suspected, the owner and contractors must follow the OSHA lead in construction regulation 29CFR 1926.62. Workers must take care to limit the amount of lead dust generated.

According to the WDNR Concrete Recycling and Disposal Fact Sheet, building materials from remodeling or demolition debris that contain lead based paint are considered a solid waste. They may not be recycled unless an exemption is obtained from the Department (DNR Form 4400-274).

IV. UNIVERSAL WASTES

The following universal wastes were identified in the building:

Material	Location	Approximate Quantity
Fire Extinguishers-CFC	North Room	1
Thermostats-Mercury	South Room	1
Fluorescent Light Ballasts-PCB	North Room, South Room, North Pit	8
Fluorescent Light Bulbs-Mercury	North Room, South Room, North Pit, South Pit	20 Tubes, 4 Compacts

Universal wastes must be removed separately for proper disposal prior to building demolition or renovation.

V. EXCLUSIONS

This report represents the condition of the building and its visible/accessible materials at the date and the times of the onsite inspection. Hidden materials, areas within walls and ceilings, or those materials that could not be accessed at the point of inspection, over and above those stated in the inspection report, are the responsibility of the building owner and the demolition or renovation contractor.

VI. LIMITATIONS

A limited lead inspection was conducted. The results are representative only of the specific painted locations that were sampled on the building. This inspection should not be used for purposes of determining where lead safe

renovation or abatement procedures are required except where the samples were collected. This report represents the condition of the building and the visible/ accessible locations sampled at the date and the time of the onsite inspection.

The care and skill given to our procedures insures the most reliable test results possible. The findings and conclusions of KPH represent our professional opinions extrapolated from limited data. Significant limited data is gathered during the course of the building inspection. No other warranty is expressed or implied. Prior to any abatement or renovation activities, it is recommended that KPH be provided the opportunity to review such plans in order that the inspection and assessments contained herein are properly interpreted and implemented.

This report and the information contained herein are prepared for the sole and exclusive use and possession of Applied Technologies, Inc. No other person or entity may rely on this report or any information contained herein. Any dissemination of the Report or any information contained herein is strictly prohibited without prior written authorization from KPH Environmental Corp.

APPENDICES

A. ASBESTOS LABORATORY RESULTS

ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

KPH Environmental Corp

CLIENT PROJECT: ATI; 17-400-030

CEI LAB CODE: A17-1572

TEST METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 02/06/17

TOTAL SAMPLES ANALYZED: 22

SAMPLES >1% ASBESTOS: 2

TEL: 866-481-1412

www.ceilabs.com

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: ATI; 17-400-030

CEI LAB CODE: A17-1572

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
1A-NC		A2315013	Brown/Black	Roofing	None Detected
1B-NC		A2315014	Brown/Black	Roofing	None Detected
1C-NC		A2315015	Brown/Black	Roofing	None Detected
2A-NC		A2315016	Black	Roofing	None Detected
2B-NC		A2315017	Black	Roofing	None Detected
2C-NC		A2315018	Black	Roofing	None Detected
3A-NC		A2315019	Brown/White	Caulk	Chrysotile 2%
4A-NC	Layer 1	A2315020	Gray/Red	Brick	None Detected
	Layer 2	A2315020	Gray	Brick	None Detected
4B-NC	Layer 1	A2315021	Gray/Red	Brick	None Detected
	Layer 2	A2315021	Gray	Brick	None Detected
4C-NC	Layer 1	A2315022	Gray/Red	Brick	None Detected
	Layer 2	A2315022	Gray	Brick	None Detected
5A-NC		A2315023	Gray/White	Caulk	None Detected
6A-NC		A2315024	Gray/Brown	Caulk	None Detected
7A-NC		A2315025	White/Beige	Ceiling Tile	None Detected
8A-NC		A2315026	Cream/Gray	Panel	Chrysotile 15%
9A-NC		A2315027	Gray	Concrete	None Detected
9B-NC		A2315028	Gray	Concrete	None Detected
9C-NC		A2315029	Gray	Concrete	None Detected
10A-NC	Layer 1	A2315030	Cream/Red	Brick	None Detected
	Layer 2	A2315030	White	Brick	None Detected
10B-NC	Layer 1	A2315031	Cream/Red	Brick	None Detected
	Layer 2	A2315031	White	Brick	None Detected
10C-NC	Layer 1	A2315032	Cream/Red	Brick	None Detected
	Layer 2	A2315032	White	Brick	None Detected
11A-NC		A2315033	Cream/Brown	Caulk	None Detected
12A-NC		A2315034	Cream/Gray	Block	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: KPH Environmental Corp
1237 W Bruce St
Milwaukee, WI 53204

CEI Lab Code: A17-1572
Date Received: 02-02-17
Date Analyzed: 02-03-17
Date Reported: 02-06-17

Project: ATI; 17-400-030

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
1A-NC A2315013	Roofing	Heterogeneous Brown/Black Fibrous Bound	25% 	Fiberglass 	10% 55% 10%	Gravel Tar Silicates	None Detected
1B-NC A2315014	Roofing	Heterogeneous Brown/Black Fibrous Bound	25% 	Fiberglass 	10% 55% 10%	Gravel Tar Silicates	None Detected
1C-NC A2315015	Roofing	Heterogeneous Brown/Black Fibrous Bound	25% 	Fiberglass 	10% 55% 10%	Gravel Tar Silicates	None Detected
2A-NC A2315016	Roofing	Heterogeneous Black Fibrous Bound	65% 	Cellulose 	35%	Tar	None Detected
2B-NC A2315017	Roofing	Heterogeneous Black Fibrous Bound	65% 	Cellulose 	35%	Tar	None Detected
2C-NC A2315018	Roofing	Heterogeneous Black Fibrous Bound	65% 	Cellulose 	35%	Tar	None Detected
3A-NC A2315019	Caulk	Heterogeneous Brown/White Fibrous Bound	2% 	Cellulose 	96%	Caulk	**2% Chrysotile**

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: KPH Environmental Corp
1237 W Bruce St
Milwaukee, WI 53204

CEI Lab Code: A17-1572
Date Received: 02-02-17
Date Analyzed: 02-03-17
Date Reported: 02-06-17

Project: ATI; 17-400-030

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
4A-NC Layer 1 A2315020	Brick	Heterogeneous Gray/Red Fibrous Bound	2%	Cellulose	10% 88%	Paint Binder	None Detected
Layer 2 A2315020	Brick	Heterogeneous Gray Fibrous Bound	2%	Cellulose	5% 55% 38%	Paint Binder Silicates	None Detected
4B-NC Layer 1 A2315021	Brick	Heterogeneous Gray/Red Fibrous Bound	2%	Cellulose	10% 88%	Paint Binder	None Detected
Layer 2 A2315021	Brick	Heterogeneous Gray Fibrous Bound	2%	Cellulose	5% 55% 38%	Paint Binder Silicates	None Detected
4C-NC Layer 1 A2315022	Brick	Heterogeneous Gray/Red Fibrous Bound	2%	Cellulose	10% 88%	Paint Binder	None Detected
Layer 2 A2315022	Brick	Heterogeneous Gray Fibrous Bound	2%	Cellulose	5% 55% 38%	Paint Binder Silicates	None Detected
5A-NC A2315023	Caulk	Heterogeneous Gray/White Fibrous Bound	2% 3%	Cellulose Talc	10% 85%	Paint Caulk	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: KPH Environmental Corp
1237 W Bruce St
Milwaukee, WI 53204

CEI Lab Code: A17-1572
Date Received: 02-02-17
Date Analyzed: 02-03-17
Date Reported: 02-06-17

Project: ATI; 17-400-030

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
6A-NC A2315024	Caulk	Heterogeneous Gray/Brown Fibrous Bound	2%	Cellulose	10% 88%	Paint Caulk	None Detected
7A-NC A2315025	Ceiling Tile	Heterogeneous White/Beige Fibrous Loosely Bound	65% 10%	Cellulose Fiberglass	10% 15%	Paint Perlite	None Detected
8A-NC A2315026	Panel	Heterogeneous Cream/Gray Fibrous Bound	5%	Cellulose	10% 70%	Paint Binder	**15% Chrysotile**
9A-NC A2315027	Concrete	Heterogeneous Gray Fibrous Tightly Bound	<1%	Cellulose	5% 60% 35%	Paint Binder Silicates	None Detected
9B-NC A2315028	Concrete	Heterogeneous Gray Fibrous Tightly Bound	<1%	Cellulose	5% 60% 35%	Paint Binder Silicates	None Detected
9C-NC A2315029	Concrete	Heterogeneous Gray Fibrous Tightly Bound	<1%	Cellulose	5% 60% 35%	Paint Binder Silicates	None Detected
10A-NC Layer 1 A2315030	Brick	Heterogeneous Cream/Red Fibrous Tightly Bound	2%	Cellulose	10% 88%	Paint Binder	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: KPH Environmental Corp
1237 W Bruce St
Milwaukee, WI 53204

CEI Lab Code: A17-1572
Date Received: 02-02-17
Date Analyzed: 02-03-17
Date Reported: 02-06-17

Project: ATI; 17-400-030

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 A2315030	Brick	Homogeneous White Fibrous Tightly Bound	2%	Cellulose	60% 38%	Binder Silicates	None Detected
10B-NC Layer 1 A2315031	Brick	Heterogeneous Cream/Red Fibrous Tightly Bound	2%	Cellulose	10% 88%	Paint Binder	None Detected
Layer 2 A2315031	Brick	Homogeneous White Fibrous Tightly Bound	2%	Cellulose	60% 38%	Binder Silicates	None Detected
10C-NC Layer 1 A2315032	Brick	Heterogeneous Cream/Red Fibrous Tightly Bound	2%	Cellulose	10% 88%	Paint Binder	None Detected
Layer 2 A2315032	Brick	Homogeneous White Fibrous Tightly Bound	2%	Cellulose	60% 38%	Binder Silicates	None Detected
11A-NC A2315033	Caulk	Heterogeneous Cream/Brown Fibrous Bound	2%	Cellulose	10% 88%	Paint Caulk	None Detected
12A-NC A2315034	Block	Heterogeneous Cream/Gray Fibrous Bound	2%	Cellulose	10% 55% 33%	Paint Binder Silicates	None Detected

LEGEND:

Non-Anth	= Non-Asbestiform Anthophyllite
Non-Trem	= Non-Asbestiform Tremolite
Calc Carb	= Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. Estimated measurement uncertainty available on request.

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by CEI Labs, Inc. CEI Labs makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

ANALYST: Shilpa Ladekar

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP TESTING
NVLAP LAB CODE 101768-0

ASBESTOS CHAIN OF CUSTODY

(22) A17-1572
A2315013-
A2315034

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:
CEI Lab Code:
CEI Lab I.D. Range:

COMPANY INFORMATION		PROJECT INFORMATION	
CEI CLIENT #:		Job Contact:	Dean Jacobsen
Company:	KPH Environmental Corp.	Email / Tel:	414-647-1530
Address:	1237 West Bruce Street	Project Name:	ATI
	Milwaukee, WI 53204	Project ID#:	17-400-030
Email:	dean.jacobsen@kphenvironmental.com	PO #:	
Tel:	(414) 647-1530 Fax: (414) 647-1540	STATE SAMPLES COLLECTED IN:	WI

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	24 HR	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☒	☐
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600		☐	☐	☐	☐	☐
PLM BULK	CARB 435		☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR	ISO 10312	☐	☐	☐	☐	☐	☐
TEM AIR	ASTM 6281-09	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD		☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-13			☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD			☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:

Test Until > 1%

☑ Accept Samples

☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
Dean Jacobsen	2/1/17 1700	DC	2-2-17 9:10

Samples will be disposed of 30 days after analysis

A17.1572

ASBESTOS SAMPLING FORM

CEI LABS

COMPANY CONTACT INFORMATION	
Company: KPH Environmental Corp.	Job Contact: Dean Jacobsen
Project Name: ATI	
Project ID #: 17-400-030	Tel: (414) 647-1530

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
1A-NC	Roofing		PLM ☒	TEM ☐
1B-NC	↓		PLM ☐	TEM ☐
1C-NC	↓		PLM ☐	TEM ☐
2A-NC	↓		PLM ☐	TEM ☐
2B-NC	↓		PLM ☐	TEM ☐
2C-NC	↓		PLM ☐	TEM ☐
3A-NC	Caulk		PLM ☐	TEM ☐
4A-NC	Brick		PLM ☐	TEM ☐
4B-NC	↓		PLM ☐	TEM ☐
4C-NC	↓		PLM ☐	TEM ☐
5A-NC	Caulk		PLM ☐	TEM ☐
6A-NC	↓		PLM ☐	TEM ☐
7A-NC	Tile		PLM ☐	TEM ☐
8A-NC	Panel		PLM ☐	TEM ☐
9A-NC	Concrete		PLM ☐	TEM ☐
9B-NC	↓		PLM ☐	TEM ☐
9C-NC	↓		PLM ☐	TEM ☐
10A-NC	Brick		PLM ☐	TEM ☐
10B-NC	↓		PLM ☐	TEM ☐
10C-NC	↓		PLM ☐	TEM ☐
11A-NC	Caulk		PLM ☐	TEM ☐
12A-NC	Block		PLM ☑	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐

ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

KPH Environmental Corp

CLIENT PROJECT: ATI; 17-400-030

CEI LAB CODE: A17-1572.1

TEST METHOD: PLM Gravimetric Point Count
EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 02/07/17

TEL: 866-481-1412

www.ceilabs.com

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: KPH Environmental Corp
1237 W Bruce St
Milwaukee, WI 53204

CEI Lab Code: A17-1572.1
Date Received: 02-06-17
Date Analyzed: 02-07-17
Date Reported: 02-07-17

Project: ATI; 17-400-030

ASBESTOS GRAVIMETRIC POINT COUNT PLM, EPA 600 METHOD

Client ID Lab ID	Material Description	Sample Weight (g)	Organic Material (%)	Acid Soluble Material (%)	Acid Insoluble Material (%)	ASBESTOS %	
3A-NC A2315019	Caulk	0.256	50	32	17	**0.39%**	**Chrysotile**

LEGEND: None

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: Varies with the weight and constituents of the sample (<0.25%)

REGULATORY LIMIT: >1% by weight

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by CEI Labs, Inc. CEI Labs makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. Estimated measurement uncertainty available on request. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

ANALYST: Shilpa Ladekar

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP TESTING
NVLAP LAB CODE 101768-0

ASBESTOS CHAIN OF CUSTODY

CEI LABS

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:
CEI Lab Code:
CEI Lab I.D. Range:

COMPANY INFORMATION		PROJECT INFORMATION	
CEI CLIENT #:		Job Contact:	Dean Jacobsen
Company:	KPH Environmental Corp.	Email / Tel:	414-647-1530
Address:	1237 West Bruce Street	Project Name:	ATI
	Milwaukee, WI 53204	Project ID#:	17-400-030
Email:	dean.jacobsen@kphenvironmental.com	PO #:	
Tel:	(414) 647-1530 Fax: (414) 647-1540	STATE SAMPLES COLLECTED IN:	WI

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	24 HR	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600		☐	☐	☒	☐	☐
PLM BULK	CARB 435		☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR	ISO 10312	☐	☐	☐	☐	☐	☐
TEM AIR	ASTM 6281-09	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD		☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-13			☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD			☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:

CEI Lab Code A17-1572

☐ Accept Samples
☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
	7/6/17 835		930
			2-6

Samples will be disposed of 30 days after analysis

ASBESTOS
SAMPLING FORM

CEI LABS

COMPANY CONTACT INFORMATION	
Company: KPH Environmental Corp.	Job Contact: Dean Jacobsen
Project Name: ATI	
Project ID #: 17-400-030	Tel: (414) 647-1530

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
3-NC			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
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			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐

B. LEAD PAINT LABORATORY RESULTS

CEI Labs
730 SE Maynard Road, Cary, NC 27511
Phone: (919) 481-1413 Fax: (919) 481-1442

LABORATORY REPORT
LEAD IN PAINT

Client: **KPH Environmental Corp**
1237 W Bruce St
Milwaukee, WI 53204

CEI Lab Code: C17-0058
Received: 02-02-17
Analyzed: 02-07-17
Reported: 02-07-17

Project: ATI; 17-400-030

ANALYSIS METHOD: EPA SW846 7000B

CLIENT ID	CEI LAB ID	PPM (µg/g)	CONCENTRATION % BY WEIGHT
1L-NC	CA59086	15000	**1.5**
2L-NC	CA59087	120	**0.012**
3L-NC	CA59088	200	**0.020**
4L-NC	CA59089	190	**0.019**
5L-NC	CA59090	<34	**<0.0034**
6L-NC	CA59091	89	**0.0089**
7L-NC	CA59092	<49	**<0.0049**
8L-NC	CA59093	310	**0.031**
9L-NC	CA59094	<35	**<0.0035**
10L-NC	CA59095	750	**0.075**

CEI Labs
107 New Edition Court, Cary, NC 27511
Tel: 919-481-1413 Fax: 919-481-1442

Project: ATI; 17-400-030

Lab Code: C17-0058

ANALYSIS METHOD: EPA SW846 7000B

CLIENT ID	CEI LAB ID	PPM (µg/g)	CONCENTRATION % BY WEIGHT

Reviewed By:

Tianbao Bai, Ph.D.
Laboratory Director

This method has been validated for sample weights of 0.020g or greater. When samples with a weight of less than that are analyzed those results fall outside of the scope of accreditations.
*** The analysis of composite wipe samples as a single samples is not included under AIHA accreditation.**

Minimum reporting limit is 10 µg total lead. Sample results denoted with a "less than" (<) sign contain less than 10.0 µg total lead, based on a 40ml sample volume.

Lead samples are not analyzed by CEI Labs Lead samples are submitted to an AIHA ELLAP accredited laboratory for lead analysis of soil, dust, paint, and TCLP samples.
Laboratory results represent the analysis of samples as submitted by the client. Information regarding sample location, description, area, volume, etc., was provided by the client. Unless notified in writing to return samples, CEI Labs discards client samples after 30 days. This report shall not be reproduced, except in full, without the written consent of CEI Labs.

REGULATORY LIMITS
OSHA Standard: No safe limit.
Consumer Products Safety Standard: Greater than 0.06% lead by weight.
Federal Lead Standard / HUD: 0.5% lead by weight.

LEGEND
µg = microgram
ml = milliliter
ppm = parts per million
Pb = lead
g = grams
wt = weight

End of Report

(10) CA 17-0058
CA 590856-
CA 59095

METALS CHAIN OF CUSTODY

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:
CEI Lab Code:
CEI Lab I.D. Range:

COMPANY INFORMATION		PROJECT INFORMATION	
CEI CLIENT #:		Job Contact:	Dean Jacobsen
Company:	KPH Environmental Corp.	Email / Tel:	414-647-1530
Address:	1237 W. Bruce St.	Project Name:	ATI
	Milwaukee, WI 53204	Project ID#	17-400-030
Email:	dean.jacobsen@kphenvironmental.com	PO #:	
Tel: 414-647-1530	Fax: 414-647-1540	STATE SAMPLES COLLECTED IN:	WI

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR**	8 HR**	24 HR**	2 DAY	3 DAY	5 DAY
LEAD PAINT	EPA SW846 7000B				☐	☒	☐
LEAD WIPE	EPA SW846 7000B				☐	☐	☐
LEAD SOIL	EPA SW846 7000B				☐	☐	☐
LEAD AIR	NIOSH 7082				☐	☐	☐
LEAD TCLP	EPA SW846 7000B				☐	☐	☐
RCRA 8 METALS	EPA SW846 7000B				☐	☐	☐
RCRA 8 TCLP	EPA SW846 7000B				☐	☐	☐
OTHER:					☐	☐	☐

TAT IS NOT AVAILABLE. LEAD SAMPLES ARE SUBCONTRACTED FOR ANALYSIS TO AN ELLAP ACCREDITED LAB.

REMARKS:	☑ Accept Samples ☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	2/1/17 1700	DC	2-2-17 9:10

Samples will be disposed of 30 days after analysis

CA17-0058

METALS SAMPLING FORM

CEI LABS

COMPANY CONTACT INFORMATION			
Company:	KPH Environmental Corp.	Job Contact:	Dean Jacobsen
Project Name:	ATI		
Project ID #:	17-400-030	Tel:	414-647-1530

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/AREA	COMMENTS
1L-NC			
2L-NC			
3L-NC			
4L-NC			
5L-NC			
6L-NC			
7L-NC			
8L-NC			
9L-NC			
10L-NC			

C. KPH CERTIFICATION

Company Certificate

This certifies that

KPH ENVIRONMENTAL CORPORATION

1237 W BRUCE ST
MILWAUKEE WI 53204-1218

is certified under ch. DHS 159, Wis.Adm.Code as a

Asbestos Company - Primary

Certificate Issue Date: 06/06/2016
Expiration Date: 09/10/2018, 12:01 a.m.
Certification #: CAP-1432180

Wisconsin Department of Health Services
Division of Public Health
Bureau of Environmental and Occupational Health
Asbestos & Lead Section
PO Box 2659
Madison WI 53701-2659
Phone: (608) 261-6876

Shelley A Bruce

Shelley A Bruce,
Unit Supervisor

Scott Walker
Governor

Linda Seemeyer
Secretary

December 8, 2016

State of Wisconsin
Department of Health Services

DIVISION OF PUBLIC HEALTH
1 WEST WILSON STREET
P O BOX 2659
MADISON WI 53701-2659

Telephone: 608 266-1251
FAX: 608 267-2832
TTY: 888-701-1253
dhs.wisconsin.gov

DEAN T JACOBSEN
W131S6781 KIPLING DR
MUSKEGO WI 53150-3401

ID# AII-14370

Congratulations! Your new Wisconsin certification card is enclosed. Call us right away if anything on your blue card is wrong.

Follow Wisconsin law by making sure that you:

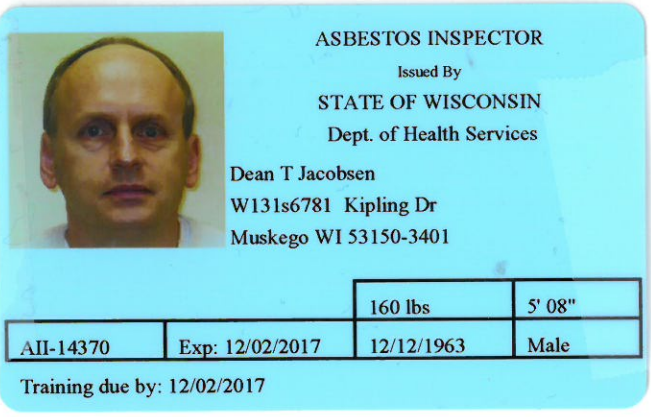
1. Have your blue card with you when doing regulated work.
2. Work safely using the methods you learned in training.
3. Keep your mailing address up to date. We mail a reminder when it's time to renew your blue card. Update your address by emailing DHSAsbestosLead@wi.gov, by using our Lead and Asbestos Online Certification website, www.dhs.wisconsin.gov/waldo, or by mailing a note to:

   Lead and Asbestos Section
   1 W. Wilson St., Room 137
   P.O. Box 2659
   Madison WI 53701-2659

4. Take refresher training well before the "Training due by" date printed on your blue card.
   - Asbestos-certified individuals must refresh in Wisconsin no earlier than **90 days** before the due date to keep the same expiration date.
     Find asbestos training providers at www.dhs.wisconsin.gov/asbestos.
   - Lead-certified individuals can refresh up to **1 year** before the due date.
     Find lead training providers at www.dhs.wisconsin.gov/lead.
5. Apply to renew your card at least **1 month** before the "Exp." date on your blue card.
6. Be associated with a certified company when doing regulated work in Wisconsin. If you work for yourself, you must certify your own company under a name of your choosing. Otherwise, you must be employed by a certified company. Get a company application form at www.dhs.wisconsin.gov/lead or www.dhs.wisconsin.gov/asbestos.
7. **Don't** conduct regulated work after your blue card expires. This could result in an enforcement action.

By getting certified and working safely, you protect y
professional responsibility. Contact us if you have a
below and on the back of your blue card.

The Lead and Asbestos Certification Program
(608) 261-6876
DHSAsbestosLead@wi.gov
www.dhs.wisconsin.gov/asbestos
www.dhs.wisconsin.gov/lead



COPY

Scott Walker
Governor

Tom Engels
Interim Secretary

August 15, 2016

State of Wisconsin
Department of Health Services

DIVISION OF PUBLIC HEALTH
1 WEST WILSON STREET
P O BOX 2659
MADISON WI 53701-2659

Telephone: 608 266-1251
FAX: 608 267-2832
TTY: 888-701-1253
dhs.wisconsin.gov

DEAN T JACOBSEN
W131S6781 KIPLING DR
MUSKEGO WI 53150-3401

ID# LRA-14370

Congratulations, your new card for Wisconsin asbestos or lead certification is enclosed. Please contact our office immediately if any of the information on the card is incorrect.

You must have this card with you whenever you are at a regulated asbestos or lead work site.

Renewing Your Certification
You may not perform regulated asbestos or lead activities after the expiration date on your card.

Asbestos Disciplines: Schedule your *annual* asbestos refresher training 30-90 days before your training due date and submit your renewal application online or by mail **at least one month before your current card expires**.

Lead Disciplines: Schedule your lead refresher training up to 12 months before the training due date and submit your renewal application online or by mail **at least one month before your current card expires**.

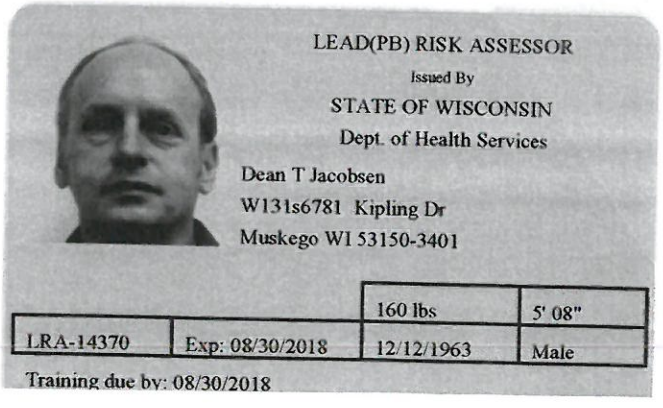
Submit your renewal application by mail if paying by check or money order, or online at **www.dhs.wisconsin.gov/waldo** if paying by VISA or MasterCard credit or debit card.

Certified Company Affiliation
You must be affiliated with an appropriately certified Asbestos, Exterior Asbestos, Lead or Lead-Safe Company by ownership, employment or contract before you may perform regulated lead or asbestos work in Wisconsin. Contact the Asbestos and Lead Section for more information.

To Update Information and Apply Online
You may make changes to your mailing address, other contact information, or your employer information by going to **www.dhs.wisconsin.gov/waldo** and selecting Asbestos and Lead Online Certification. You may also send changes in writing to the Asbestos and Lead Section at the address below.

Asbestos and Lead Section, Room 137
P.O. Box 2659
Madison WI 53701-2659

Phone: (608) 261-6876
Email: dhsasbestoslead@wi.gov
Internet: www.dhs.wisconsin.gov



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SECTION 02230

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris.
2. Removing designated paving, curbs, sidewalls and unsatisfactory base materials.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.

1.2 QUALITY ASSURANCE

A. Conform to applicable codes for disposal of debris.

B. Coordinate clearing work with utilities.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing plant life and features designated to remain are tagged or identified.

3.2 PROTECTION

A. Locate, identify, and protect utilities indicated to remain, from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.3 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove trees and shrubs within marked areas and as indicated. Remove trees, shrubs, stumps, surface rock, and roots.

C. Clear undergrowth and deadwood, without disturbing subsoil.

3.4 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

B. Remove paving, curbs, sidewalks, and unsatisfactory base materials.

C. Remove abandoned utilities within limits of construction or as shown. Indicated removal termination point for underground utilities on Record Documents.

D. Continuously clean up and remove waste materials from site. Do not allow materials to accumulate on site.

E. Do not burn or bury materials on site. Leave site in clean condition.

END OF SECTION

SECTION 02311

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating topsoil.
   2. Excavating subsoil.
   3. Cutting, grading, filling, rough contouring, compacting site for site structures.

1.2 REFERENCES

A. State of Wisconsin, Department of Transportation Standard Specifications for Highway and Structure Construction, 2016 Edition, with most recent Supplemental Specifications, hereinafter referred to as the Standard Specifications.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Samples: Submit, in air-tight containers, 30 lb sample of structural fill to testing laboratory.

C. Materials Source: Submit name of imported materials suppliers.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil: Excavated and reused material, graded, free of roots, rocks larger than ½ inch, subsoil, debris, large weeds and foreign matter. Single screened.

B. Structural Fill: As specified in Section 02320.

C. Granular Fill: As specified in Section 02320.

D. Stockpile / Spoils Stabilization: Borrow Pit Seed Mix as specified in the Standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

B. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location of utilities.

C. Identify required lines, levels, contours, and datum.

D. Notify utility company to remove and relocate utilities.

E. Protect utilities indicated to remain from damage.

F. Protect plant life, lawns, and other features remaining as portion of final landscaping.

G. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

H. Stockpile excavated topsoil and subsoil in area designated onsite to depth not exceeding 8 feet and protect from erosion. Contractor may use the City's WWTF site (3003 5th Avenue.) for temporary stockpiling of excavated soil materials. No demolition debris will be allowed. Provide erosion control measures for stockpiles at the WWTF site. Keep topsoil separate from subsoil stockpiles. Remove excess spoils from the site prior to completion of construction and restore site to original condition.

3.3 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading. In areas to be regraded with excess fill, strip all of topsoil prior to placement of excess fill and regrading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated onsite to depth not exceeding 8 feet and protect from erosion.

D. Remove excess topsoil not intended for reuse, from site.

E. Provide stabilization of stockpiles and spoils with seeding as required for erosion control. Seeding shall be as specified for borrow pits and material disposal sites in the Standard Specifications.

3.4 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.

B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

C. Stockpile excavated material in area designated on site and protect from erosion.

D. Benching Slopes. Horizontally bench existing slopes greater than 1:4 to key placed fill material to slope to provide firm bearing.

E. Stability: Replace damaged or displaced subsoil as specified for fill.

F. Remove excess subsoil not intended for reuse, from site.

3.5 FILLING

A. Fill areas to contours and elevations with unfrozen materials.

B. Place fill material in continuous layers and compact in accordance with Section 02320.

C. Maintain optimum moisture content of fill materials to attain required compaction density.

D. Slope grade away from building minimum 1 percent, unless noted otherwise.

E. Make grade changes gradual. Blend slope into level areas.

F. Repair or replace items indicated to remain damaged by excavation or filling.

3.6 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Testing: In accordance with ASTM D698, ASTM D2922 and ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION

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SECTION 02315

EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating for building foundations.
2. Excavating for paving, roads, and parking areas.
3. Excavating for slabs-on-grade.
4. Excavating for site structures.
5. Excavating for landscaping.
6. Excavating for utilities.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location of utilities.

C. Identify required lines, levels, contours, and datum.

3.2 EXCAVATION

A. Provide shoring, tight sheeting, bracing or other supporting structures to protect existing surface and subsurface structures, and to comply with regulatory requirements.
1. Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Provide shoring, tight sheeting, and bracing required to excavate for and construct all below grade structures on site.

2. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at 24 inches below required grade elevation.

B. Underpin adjacent structures that may be damaged by excavation work, including utilities and pipe chases. All poles, buildings, fences, and other surface structures shall be protected and preserved by the Contractor and shall be repaired or replaced if necessary and left in as good condition as before Work started. All pipes conduits, sewers, drains, foundations, and other subsurface structures shall be properly supported and protected during and after construction and repaired or replaced, if necessary, and left in as good condition as before Work started.

C. Excavate subsoil to accommodate building foundations, slabs-on-grade paving and site structures.

D. Excavate to working elevation for piling work.

E. Compact disturbed load-bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02320 and 02324.

F. Slope banks with machine to angle of repose or less until shored.

G. Do not interfere with 45 degree bearing splay of foundations.

H. Grade top perimeter of excavation to prevent surface water from draining into excavation.

I. Trim excavation. Remove loose matter. Remove lumped subsoil, boulders, and rocks.

J. Notify Architect/Engineer of unexpected subsurface conditions.

K. Correct over excavated areas as specified in Section 02320 and as directed by Architect/Engineer.

L. Stockpile subsoil in area designated to depth not exceeding 8 feet and protect from erosion.

M. Reuse excavated spoil materials as common fill onsite.

N. Removal of Water: The contractor shall provide and operate a dewatering system as necessary to prevent water from entering any excavations. Dewatering shall keep the groundwater level at least one foot below the bottom of the excavation. Dewatering shall be accomplished prior to excavation and shall be maintained until the finished work is safe from injury. Water removed from the site shall be disposed of by the contractor such that it does not damage any adjacent property or work. The Contractor shall provide acceptable silt fencing, hay bales, and/or means to remove soil or fines from the water prior to disposal. The costs of all sumps, wells, well points, piping, pumping, excavation, and other work associated with dewatering shall be borne by the Contractor. Contractor shall acquire all permits necessary for construction, operation, and removal of dewatering systems. De-watering shall comply with WDNR Conservation Practice Standard 1061.

O. Repair or replace items indicated to remain damaged by excavation.

3.3 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and Inspection Services.

B. Provide for visual inspection of bearing surfaces before installing subsequent work.

3.4 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing. Provide protection against freezing when atmospheric temperature is less than 35˚ F until backfilling operations are completed.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

D. Provide fence or barricades around open excavations. Protection must be in place at the end of each working day for active excavation, and left in place for completed excavations.

END OF SECTION

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SECTION 02320

BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.
4. Fill under paving.
5. Fill for over-excavation.
6. Site filling and backfilling.
7. Compaction.
8. Controlled low strength material fill for below grade abandoned structures.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society for Testing and Materials:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
7. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for geotextile fabric indicating fabric and construction.

C. Samples: Submit, in air-tight containers, 30 lb sample of each type of fill to testing laboratory.

D. Materials Source: Submit name of imported fill materials suppliers.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 FILL MATERIAL

A. Crushed Stone:

1. Crushed Stone: Imported stone processed by mechanical crushing of rock with substantially all faces fractured by the crushing; free of shale, clay, friable material, sand, debris; graded in accordance with ASTM C33 Size No. 67 within the following limits

Gradation Requirements for Crushed Stone:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	90 to 100
3/8 inch	20 to 55
No. 4	0 to 10
No. 8	0 to 5

B. Bedding/Cover Material:

1. Crushed Stone Chips: Crushed stone chips shall be made from crushing sound limestone, dolomite ledge rock, or other rock materials of regional significance. The material shall be hard, tough and durable. The crushing process shall produce material of which 85% to 100% of the particle shall have at least one machine fractured face, crushed pea gravel will be acceptable if it meets this criteria:

Gradation Requirements for Crushed Stone Chips:

Sieve Size	Percent Passing
1/2 inch	100%
3/8 inch	90 to 100
No. 8	0 to 15
No. 30	0 to 3

2. Bedding Sand: Bedding sand shall consist of durable particles ranging in size from fine to coarse in a substantially uniform combination. The presence of approximately 6% of fine clay or loam particles is desirable, but clay or loam lumps are not permitted. The maximum moisture content shall be 10%

Gradation Requirements for Bedding Sand:

Sieve Size	Percent Passing
1 inch	100%
No. 16	45 to 80
Finer Than No. 200	2 to 10

C. Sand or Gravel: Well grade sand or gravel; free of clay and silt lumps, loam, friable of soluble materials, or organic matter meeting the following:

1. Gravel:

Sieve Size	Percent Passing
1 inch	95 to 100
3/4 inch	70 to 90
3/8 inch	50 to 85
No. 4	35 to 65
No. 10	25 to 50
No. 40	10 to 30
No. 200	0 to 5

2. Sand:

Sieve Size	Percent Passing
3/8 inch	75 to 95
No. 4	60 to 80
No. 30	15 to 35
No. 200	0 to 5

D. Granular Backfill: Fine to coarse-graded sand; free of clay and silt lumps, loam, friable or soluble materials, or organic matter; graded in accordance with ASTM C136, within the following limits:

Sieve Size	Percent Passing
1 inch	100
No. 16	45 to 80
No. 200	2 to 10

E. Structural Fill (Engineered Fill): Compacted fill shall be processed soil or rock materials free of deleterious, friable, soluble, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as "contaminated", and shall be low-expansive with a maximum Liquid Limit (ASTM D-423) of 30 and a Plasticity Index (ASTM D-424) of 15. The top 12-inches of the compacted fill shall have a maximum particle size of 3-inch diameter and all underlying compacted fill shall have a maximum particle size of 6-inch diameter. All fill materials must be tested and approved by the Engineer prior to delivery to the site. **Note: Onsite materials at are not considered suitable as structural fill and shall not be used as structural fill.**

F. Rip Rap: Stone pieces ranging in weight from approximately 25 to 150 pounds, with not less than 50 percent of pieces weighing more than 60 pounds.

G. Heavy Rip Rap: Field Stones, well-graded, ranging in weight up to approximately 400 pounds. Not less than 50 percent of the total volume shall consist of stones weighing at least 150 pounds, and not less than 80 percent of the total volume shall consist of stones weighing at least 40 pounds.

H. Common Fill: Soil, free of non-earth materials, less than 7% organic content defined by Loss-on-Ignition. Test ASTM D-2974, and maximum particle size of 8-inches.

I. Base Course: As specified in Section 02721.

J. Drainage Stone: Graded in accordance with ASTM C33 coarse aggregate, Size No. 57 within the following limits:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	Maximum 10

K. Breaker Run Stone: Large-sized aggregate resulting from the mechanical crushing of rock, boulders, large stone or salvaged concrete, the results of which are not screened or processed beyond the initial crushing size. Breaker run stone shall be graded within the following limits:

Sieve Size	Percent Passing
5 inch	100
1½ inch	0 to 50

L. Fill materials shall be stored and handled by methods that prevent segregation of particle sizes or contamination by mixing with other materials.

2.2 GEOTEXTILE FILTER FABRIC

A. Non-woven, manufactured with the following minimum average roll values from samples in accordance with ASTM D4354. (The following values may be obtained from the manufacturer.)

Property	ASTM Test	
	Value	Method
Grab Strength	180 lbs.	D4632
Seam Strength(a)	160 lbs.	D4632
Puncture Strength	80 lbs.	D3787
Burst Strength	290 lbs./in2	D3786
Trapezoidal Tear	50 lbs.	D4533
AOS	Greater than No. 30 sieve (less than 0.6mm)	D4751

(a)Alternatively, overlap geotextile a minimum of 18 inches.

B. Protect geotextile during storage from becoming wet, coming in contact with soil, cement, or other foreign materials, and from exposure to sunlight.

C. Geotextile Fabric, Type HR: Shall comply with Section 645 of WISDOT Standard Specifications for use with medium rip-rap.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

D. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth recommended by engineer.

D. Proofroll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

E. Prior to placement of aggregate base course material at paved areas, compact subsoil to 95 percent of its maximum dry density in accordance with ASTM D1557.

3.3 BACKFILLING

A. Backfill areas to contours and elevations with unfrozen materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Place geotextile fabric where required prior to placing next lift of fill.

D. Place and compact fill material in continuous layers not exceeding 8 inches compacted depth and compact in accordance with schedule at end of this section.

E. Employ placement method that does not disturb or damage other work.

F. Maintain optimum moisture content of backfill materials to attain required compaction density.

G. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.

H. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

I. Backfill only against concrete that has been properly cured, coated, tested and accepted.

J. Fill excavations below bottom of foundation or footing elevations within influence zone with concrete or structural fill.

K. Begin compaction of each layer at structure wall.

L. Utilize compactors of 550 lbs or less in weight within 5 feet of structure wall.

3.4 TOLERANCES

A. Top Surface of Backfilling Within Building Areas: Plus or minus 1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 3 inches from required elevations.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Testing: In accordance with ASTM D1557, ASTM D2922, ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

D. Proof roll compacted fill surfaces under paving.

3.6 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Protecting finished work.

B. Reshape and re-compact fills subjected to vehicular traffic.

3.7 SCHEDULE

A. Mat Foundation and Interior Slab-On-Grade:
   1. Existing soils or structural fill to 6 inches below subgrade soils or structural fill to 6 inches below subgrade elevation compacted to 95 percent and sand or gravel fill to subgrade compacted to 95 percent unless noted otherwise on Drawings.

B. Exterior Side of Foundation Walls and Retaining Walls:
   1. Granular Backfill, within 4 – 6 feet from walls, to 1–2 feet below subgrade elevation, each lift compacted to 90 percent; compacted clayey soils to subgrade.

C. Fill in Abandoned, Below Grade Structures
   1. Granular backfill to 24 inches below finished grade, each lift compacted to 90%.
   2. Remaining fill as specified below to finish grade.

D. Fill Under Grass Areas:
   1. Common fill, to 6 inches below finish grade, compacted to 85 percent.

E. Fill Under Landscaped areas and fill for Berm:
   1. Common fill, to 12 inches below finish grade, compacted to 85 percent.

E. Fill Under Asphalt and Concrete Paving:
   1. Structural fill, to 12 inches below base course subgrade finish paving elevation, compacted to 95 percent, and structural fill to subgrade elevation compacted to 100 percent.

F. Fill to Correct Over-excavation:
   1. Structural fill, flush to required elevation, compacted to 95 percent.

G. Fill to Prevent Erosion:
   1. 12-inch minimum medium rip rap placed over non-woven geotextile Type HR

3.8 SECURITY

A. Provide security and facilities to protect Work, and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

END OF SECTION

SECTION 02324

TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating trenches for utilities, culverts, storm and sanitary sewers, drains, and piping to limits shown on the Drawings.
2. Compacted bedding.
3. Backfilling and compaction.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society for Testing and Materials:
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

C. Product Data: Submit data for geotextile fabric indicating fabric and construction.

D. Materials Source: Submit name of imported fill materials suppliers.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

B. Verify that survey benchmark and intended elevations for the Work are as shown on Drawings.

C. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

1.6 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Trench backfill above pipe zone shall be Structural Fill or Common Fill materials as specified and scheduled in Section 02320.

2.2 TRENCH STABILIZATION:

A. Crushed Stone: As specified for Crushed Stone in Section 02320.

2.3 PIPE ZONE MATERIALS:

A. Bedding Material:
   1. For pipes larger than 18-inches in diameter, as specified for Crushed Stone in Section 02320.
   2. For pipes 18-inches in diameter or less, as specified for Bedding/Cover Material in Section 02320.

B. Pipe zone materials shall be cover material as follows:
   1. For trenches with Class “B” bedding, cover material shall be as specified for Crushed Stone in Section 02320 for pipes larger than 18-inches in diameter; cover material shall be as specified for Bedding/Cover Material in Section 02320 for pipes 18-inches in diameter or less.
   2. For trenches with Class “C” bedding, cover material shall be as specified for Structural Fill in Section 02320.

2.4 CONCRETE ENCASEMENT

A. Provide concrete encasement where shown on the Drawings or required by the specifications. Concrete shall conform to the requirements of Section 03300.

PART 3 EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings. Owner reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Verify that fill materials to be reused are acceptable prior to use.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Excavate subsoil required for installation of utilities.

B. Remove lumped subsoil, boulders, and rock.

C. Cut trenches sufficiently wide to enable installation as shown on the Drawings and allow inspection. Remove water or materials that interfere with Work. Provide dewatering in accordance with Section 02315.

D. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.

E. Do not interfere with 45 degree bearing splay of foundations. Provide shoring to protect existing foundations when excavating adjacent buildings and structures.

F. When Project conditions permit, slope side walls of excavation. When side walls can not be sloped, provide sheeting and shoring to protect excavation as specified in this section.

G. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth until suitable material is encountered.

H. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Structural Fill and compact to density equal to or greater than requirements for subsequent backfill material.

I. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

J. Correct over excavated areas with compacted backfill as specified for authorized excavation.

K. Remove excess subsoil not intended for reuse, from site.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BEDDING

A. Support pipe and conduit during placement and compaction of bedding fill.

B. Class B bedding shall be provided as shown on Drawings in the following locations:
1. Under all structures, footings, and slabs.
2. Under all asphalt and concrete paving.
3. Adjacent to existing structures, when pipe centerline is within 5 feet of the structure.
4. When crossing under existing piping, utilities, and duct banks.

C. Class C bedding shall be provided as shown on Drawings in the following locations:
1. Under grass and landscaped areas.

D. Provide concrete encasement where shown on the Drawings or required by the Specifications.

3.6 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place geotextile fabric where required.

D. Place fill material in continuous layers not exceeding 8 inches compacted depth.

E. Employ placement method that does not disturb or damage foundation perimeter drainage, or utilities in trench.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Protect open trench to prevent danger to Owner and the public.

3.7 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 3 inches from required elevations.

3.8 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Compaction Testing: In accordance with ASTM D698, ASTM D2922, ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest. At no cost to Owner.

3.9 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Protecting finished work.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

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SECTION 02611

PVC BELL AND SPIGOT GRAVITY SEWER PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. PVC sewer pipe with bell and spigot joints.

1.2 REFERENCE SPECIFICATIONS

A. The Standard Specifications for Sewer and Water Construction in Wisconsin, latest edition, hereinafter referred to as the “Standard Specifications.”

B. ASTM International:
   1. ASTM F477: Elastomeric Seals (Gaskets) for joining Plastic Pipe.
   2. ASTM F679: PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings
   3. ASTM F794: PVC Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
   4. ASTM D1784: Specification for Rigid PVC Compounds and CPVC Compounds.
   5. ASTM D3034: Type PSM PVC Sewer Pipe and Fittings.
   6. ASTM D3212: Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

1.3 SUBMITTALS

A. As specified in Section 01330.

B. Certification that the pipe materials comply with the requirements of this Specification Section.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. Pipe:
   1. 15-inch and smaller: Polyvinyl Chloride (PVC) sewer pipe, SDR 26 heavy wall, meeting the requirements of ASTM D3034.
   2. 18-inch through 36-inch: Polyvinyl Chloride (PVC) sewer pipe, PS 115 heavy wall, meeting the requirements of ASTM F679.

B. Performance:
   1. Impact resistance: No shattering or splitting shall be evident (denting is not considered a failure) when tested in accordance with ASTM D2444.
   2. Pipe Stiffness:
      a. Performance: Minimum 115 psi "Pipe Stiffness" (F/ y) at 5% deflection for all pipe sizes.

b. Test method: Testing in accordance with ASTM D2412, "External Loading Properties of Plastic Pipe by Parallel-Plate Loading."

3. Joint tightness: Tested in accordance with ASTM D3212.

4. Flattening:

a. Performance: No evidence of splitting, cracking, or breaking when tested.

b. Test method: Flatten specimen of pipe, six inches long between parallel plates in a suitable press until the distance between the plates is forty percent of outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed two to five minutes.

5. Testing temperature: 73º F ± 3º F.

C. Joints: Push-on type bell and spigot configuration compatible with that of the pipe and in accordance with ASTM D3212 requirements, with elastomeric ring gasket complying with ASTM F477.

D. Fittings: Fittings such as elbows, tees, wyes, and others shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe, meeting the requirements of ASTM D3212, ASTM F477, ASTM D3034.

2.2 LUBRICANT

A. Provide manufacturer's standard for pipe and gasket materials.

PART 3 WORKMANSHIP

3.1 HANDLING PIPE

A. Handle pipe in accordance with manufacturer's instructions. Do not handle pipe with chains or cables. Do not drop pipe.

3.2 CUTTING PIPE

A. Saw cut pipe in accordance with manufacturer's instructions. All cuts to be square, perpendicular to pipe axis, within tolerance of joints.

3.3 DRESSING CUT ENDS

A. Dress cut ends of pipe in accordance with the type of joint to be made.

B. Dress cut ends of mechanical joint pipe to remove sharp edges or projections that may damage the rubber gasket.

C. Dress cut ends of push-on joint pipe by leveling, as recommended by the pipe manufacturer.

3.4 JOINTING PIPE

A. Join pipe in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstances.

3.5 TESTING

A. Leakage Testing: The “low pressure air test” method of leakage testing shall be required in accordance with Section 3.7.3 of the Standard Specifications. Testing shall be conducted by the Contractor under the observation of the Inspector.

B. Deflection Testing: Deflection testing of PVC sewer pipe shall be required in accordance with Section 3.2.6(i)4 of the Standard Specifications. Testing shall be conducted by the Contractor under the observation of the Inspector. The Contractor shall submit all test results to the Engineer.

END OF SECTION

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SECTION 02630

STORM DRAINAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Storm drainage piping.
2. Accessories.
3. Catch basins and plant area drains.
4. Cleanouts.
5. Bedding and cover materials.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society for Testing and Materials:
1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
3. ASTM C14M - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).
4. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
5. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric).
6. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
7. ASTM C443M - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).
8. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
9. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
10. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
11. ASTM C969M - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric).
12. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
13. ASTM C1103M - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric).
14. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

15. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
16. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
17. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
18. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
19. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
20. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
21. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
22. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
23. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
24. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
25. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data indicating pipe, pipe accessories, and castings.

C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with applicable State and Local Codes Governing Work.

1.6 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate the Work with termination of storm sewer connection outside building, trenching, connection to foundation drainage system.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Pipe for diameters 12-inch and larger: ASTM C76 Class IV with Wall Type B; inside nominal diameter as shown on the Drawings, bell and spigot ends.
   1. Fittings: Reinforced concrete.
   2. Joints: ASTM C443 rubber compression gasket.
   3. Flared End Sections: ASTM C76

B. PVC sewer pipe for diameters less that 12-inch: ASTM D3034, SDR 35, inside nominal diameter as shown on the Drawings, bell and spigot ends.
   1. Joints: ASTM D3212 elastomeric.

C. Smooth Interior HDPE pipe for diameters 12-inch and larger shall meet AASHTO M294, Type S or ASTM F2306.
   1. Joints: ASTM F477.
   2. Flared End Sections shall be corrugated metal.

D. Tracer Wire is required on all PVC and HDPE storm drainage piping. Tracer wire shall be Neptco Trace-Safe Sewer blocking tracer wire RT 1802W (Green) with 19 gauge conductor and 1,800 pond strength (minimum).
   1. All ends shall terminate in Rhino TriView Tracer Ped Green/Sewer tracer wire station with internal terminals.
   2. Provide sufficient length for test station installation height of 4 feet above finished grade.
   3. Perform continuity testing supervised by owner or engineer at each test station to demonstrate continuity after completion of pipe installation. Submit report to document results.
   4. Find or repair continuity issues in accordance with the manufacturers recommendations and instructions.

2.2 ACCESSORIES

A. Filter Fabric: Non-biodegradable, as specified in section 02320.

B. Grout: Specified in Section 03300.

2.3 CATCH BASINS AND PLANT AREA DRAINS

A. Catch Basin Lid and Frame Manufacturers/Model:
   1. Neenah Foundry Company
      a. Curb inlet:
         1) 2’x3’ rectangular: R-3246 or equal
         2) 36” diameter round: R3235 or equal
      b. Yard: R1500 or equal

c. Catch Basin: R-2502-D, or equal
d. Detention Pond Outlet: R-2595-A.

2. Substitutions: Refer to Section 01600 - Product Requirements.

B. Catch Basin Lid and Frame:
1. Construction: Cast iron construction, hinged lid.
2. Lid Design: As shown on the Drawings.
3. Nominal Lid and Frame Size: As shown on the Drawings.
4. Catch basin components shall be suitable for AASHTO H-20 loadings.

C. Shaft Construction and Cone Top Section: Reinforced precast Concrete pipe sections, conforming to section 02633.

D. Base Pad: As specified in Section 02633.

2.4 BEDDING AND COVER MATERIALS

A. Bedding: Minimum 6 inches Crushed Stone, as specified in Section 02320.

B. Cover: Minimum 12 inches of Crushed Stone, as specified in Section 02320.

C. Fill Materials: Trench backfill above pipe zone shall be structural fill or common fill materials as specified and scheduled in Section 02320.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify trench cut and excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation as specified in Section 02320.

B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 02324 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth.

C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal joints watertight.

B. Place pipe on minimum 6 inch deep bedding material.

C. Lay pipe to slope gradients noted on drawings with maximum variation from indicated slope of 1/8 inch in 10 feet.

D. Refer to Section 02320 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.

E. Refer to Section 02633 for manhole requirements.

F. Connect to subdrainage tile system piping. Refer to Section 02620 if applicable.

G. Install site storm drainage system piping to within 5 feet of building. Connect to building storm drainage system. Refer to Section 15160 if applicable.

3.5 INSTALLATION - CATCH BASINS AND INLETS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place Cast-In-Place Concrete base pad, with provision for storm sewer pipe end sections.

C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

D. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.

E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.6 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Request inspection prior to and immediately after placing aggregate cover over pipe.

C. Deflection Test
1. Perform deflection tests on all PVC gravity sewer pipe.
2. Pipe deflection shall not exceed 5%.
3. Conduct tests a minimum of 30 days after backfill has been placed.
4. Pull test mandrel without mechanical means.
5. Provide mandrels in accordance with the following:
   a. PVC SDR 35 (ASTM D3034)

Pipe Size (inches)	Mandrel Size (inches)
8	7.28
10	9.08
12	10.79
15	13.20

b. PVC (ASTM F679)

Pipe Size (inches)	Wall Thickness	Mandrel Size (inches)
18	T-1A	16.13
18	T-2B	16.20
21	T-1A	19.00
21	T-2B	19.09
24	T-1A	21.36
24	T-2B	21.46
27	T-1A	24.06
27	T-2B	24.17

3.7 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
   1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
   2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION

SECTION 02633

MANHOLES, FRAMES, AND COVERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Monolithic concrete manholes with masonry transition to cover frame, covers, anchorage, and accessories.
   2. Modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to cover frame, covers, anchorage, and accessories.

1.2 REFERENCES

A. Standard Specifications for Sewer & Water Construction in Wisconsin ("Standard Specifications')

B. American Concrete Institute:
   1. ACI 318 - Building Code Requirements for Structural Concrete.
   2. American Society for Testing and Materials:
   3. ASTM A48 - Standard Specification for Gray Iron Castings.
   4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   5. ASTM A536 - Standard Specification for Ductile Iron Castings.
   6. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   7. ASTM C55 - Standard Specification for Concrete Brick.
   8. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
   9. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
   10. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
   11. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 DESIGN REQUIREMENTS

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Structures: In accordance with ASTM C913.

C. Design of Joints for Precast Structures: In accordance with ASTM C913.

1.4 SUBMITTALS

A. Submit in accordance with Section 01330 - Submittal Procedures.

1. Shop Drawings: Indicate manhole locations, elevations, piping and conduit, sizes and elevations of penetrations.
2. Product Data: Submit manhole covers, component construction, features, configuration, and dimensions.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with applicable State and Local Codes governing Work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes and drainage structures.

C. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 MANHOLES, FRAMES, AND COVERS

A. Manufacturers:
1. Neenah Foundry Co. Model numbers as shown.
2. Substitutions: Section 01600 Product Requirements.

B. Manhole Sections:
1. Reinforced precast concrete:
a. Conforming to Chapter 8.39.0 of the Standard Specifications in accordance with ASTM C478 with gaskets in accordance with ASTM C923. Minimum wall thickness shall be 4 ½ inches; minimum inside diameter shall be 48 inches.
b. Manhole section joints shall be tongue and groove with compression type rubber gaskets conforming to ASTM C443 and Standard Specifications Chapter 8.39.5.
2. Reinforced cast-in-place concrete:
a. As specified in Section 03300.
b. Conform to Drawing details.
c. Use only where called for on drawings.

C. Mortar and Grout: As specified in Chapter 8.37.0 of the Standard Specifications.

D. Reinforcement: Steel reinforcement shall conform to Chapter 8.44.0 of the Standard Specifications.

E. Cover and Frame: ASTM A48 Class 30B Cast iron construction, machined flat bearing surface, as shown on the Drawings. Frames and covers not detailed on drawings shall be Neenah R-1661, non-rocking, with gasketed "B" pattern lids; or equal. Lids shall be lettered "ELECTRICAL" for electrical manholes, "SANITARY SEWER" for sanitary manholes and "STORM" for storm manholes.

2.2 COMPONENTS

A. Manhole Steps: ½-inch diameter grade 60 steel reinforcement rod encapsulated in copolymer polypropylene.

B. Base Pad: Minimum of 6" crushed rock conforming to ASTM D448 - No. 67, compacted to 95% Standard Proctor Density.

C. Manhole Extensions: Concrete grade rings for extensions shall conform to Chapter 8.39.11 of the Standard Specifications.

D. Pulling Irons: Galvanized steel bent bar as shown on the Drawings. Galvanize to ASTM A-153.

E. Concrete Insert Channels: Galvanized steel channel insert as shown on the Drawings, length to match channel rack brackets. Channels shall conform to ASTM A570 GR33, A446 GRA, with ASTM A-153 galvanizing.

F. Cable Racks and Brackets: Galvanized steel channels and brackets as shown on the Drawings, with high-glazed porcelain insulators. Conform to ASTM A570 GR33, A446 GRA, A-153. Connecting hardware shall be galvanized in accordance to ASTM B633.

G. Pipe Connectors: All connections between pipes and manholes shall be made through watertight resilient connectors as shown on the Drawings.

H. Chimney Seals: Provide internal/external type seal consisting of a flexible, EPDM rubber ring and sleeve that seals from the manhole frame to manhole cone section. Ring thickness shall be ¾" minimum, with minimum 12-inch length sleeve. Provide stainless steel clamping bands. Chimney seals shall be Adapter Inc, Cretex, or approved equal. Provide Owner with one removal/installation tool.

I. Joint Sealing: Provide 1-1/4-inch Buty L-Lok Preformed tape for installation between manhole sections, and external rubber joint wrap, minimum 9-inch wide, Cretex or SSI Products.

2.3 CONFIGURATION

A. Manhole configurations shall be as shown on the Drawings.

B. Design Depth: Provide depth to accommodate to elevations indicated on Drawings.

C. Clear Cover Opening: 26 inches or as indicated on Drawings.

D. Pipe and Conduit Entry: Furnish openings as indicated on Drawings.

E. Manholes shall be precast construction, unless shown otherwise.

F. Furnish manholes in 4 foot diameter, unless shown otherwise.

G. Establish flowline and rim elevations from grade stake provided.

H. Provide manhole riser sections in a combination of lengths which will minimize the number of joints.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify items provided by other sections of Work are properly sized and located.

C. Verify built-in items are in proper location, and ready for roughing into Work.

D. Verify correct size of manhole excavation.

3.2 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION

A. Excavation and Backfill:
   1. Excavate for manholes and drainage structures in accordance with Section 02315 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
   2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes or drainage structures in dry trench.
   3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.

B. Installation:
   1. Install manholes and drainage structures supported at proper grade and alignment on compacted crushed stone bedding as shown on Drawings.
   2. Place base pad, trowel top surface level.
   3. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.

4. Backfill excavations for manholes and drainage structures in accordance with Section 02320.
5. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As Work progresses, build fabricated metal items and accessories as shown on the Drawings.
6. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel as indicated on Drawings.
7. Set cover frames and covers level without tipping, to correct elevations.

C. Coordinate with other sections of Work to provide correct size, shape, and location.

3.4 PRECAST CONCRETE MANHOLE AND DRAINAGE STRUCTURE INSTALLATION

A. Lift precast structures at lifting points designated by manufacturer.

B. When lowering manholes and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 02320 or on other support system shown on Drawings.

D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

F. Joint sealing materials shall be installed on site.

G. Set casting frames and adjusting rings on 1-1/4-inch Buty L-Lok Preformed tape and back-plaster the inside and outside of the joint with mortar.

H. Seal manhole joints with 1-1/4-inch Buty L-Lok Preformed tape or equal, conforming to AASHTO M-198.

I. Verify manholes and drainage structures installed satisfy required alignment and grade.

J. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.

K. Fill interior joints and lift holes with mortar.

L. Cut pipe to finish flush with interior of structure.

M. Shape inverts through manhole as shown on Drawings. The manhole invert shall provide a smooth transition between channels. No sharp edges or rough sections which will tend to obstruct the flow will be permitted. Where a full section of sewer pipe is laid through the manhole, the top shall be cut out as shown or approved, and the exposed edge of the

pipe shall be completely covered with mortar. All cement mortar used in the construction of the invert shall be troweled smooth.

3.5 CAST-IN-PLACE CONCRETE MANHOLE AND DRAINAGE STRUCTURE INSTALLATION

A. Prepare crushed stone bedding or other support system shown on Drawings, to receive base slab as specified for precast structures.

B. Erect and brace forms against movement in accordance with Section 03100.

C. Install reinforcing steel as indicated on Drawings and in accordance with Section 03200.

D. Place and cure concrete in accordance with Section 03300.

3.6 CASTINGS INSTALLATION

A. Set frame and cover 2 inches above finished grade for manholes and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

B. Manhole Extensions: The extensions shall be built in accordance with the details shown on the Drawings. The actual height of extensions shall be as determined by the Engineer.

3.7 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test cast-in-place concrete in accordance with Section 03300.

C. Vertical Adjustment of Existing Manhole and Drainage Structures:
   1. Where required, adjust top elevation of existing manholes and drainage structures to finished grades shown on Drawings.
   2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
   3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated Drawings.
   4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 03300.

END OF SECTION

SECTION 02721

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Crushed aggregate base course.
   2. Leveling Course.
   3. Shoulder.

1.2 REFERENCES

A. State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, 2016 Edition, with most recent Supplemental Specifications, hereinafter referred to as the Standard Specifications.

B. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. American Society for Testing and Materials:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
   3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
   5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Samples: Submit, in air-tight containers, 30 lb sample of each type of fill to testing laboratory.

C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Crushed Aggregate Base Coarse: Section 304 of the Standard Specifications, Crushed Stone Graduation No. 2:

1. The aggregates shall consist of hard, durable particles of crushed stone or crushed gravel and a filler of natural sand, stone sand or other finely divided mineral matter. Oversize material encountered in deposits from which the material is taken shall be removed by screening or shall be crushed to the required sizes. The composite material shall be substantially free from vegetable matter, shale and lumps or balls of clay, and shall conform to the pertinent gradation requirements.
2. Unless otherwise specified in the contract, the aggregate shall have a percentage of wear of not more than 50, as determined by AASHTO Designation: T 96.
3. The aggregate, including any blended filler, shall have a liquid limit of not more than 25 and a plasticity index of not more than six except in the case of aggregates for base courses placed between old and new pavements, where the plasticity index shall not exceed three.
4. At least 45 percent, by count, of the number of particles of aggregate retained on the No. 4 sieve shall have at least one fractured face.

Graduation Requirements

	Percentage Passing By Mass			
	Gradation No. 2		Gradation No. 3	
Sieve Size	Crushed Gravel	Crushed Stone	Crushed Gravel	Crushed Stone
37.5 mm	--	--	--	--
25.0 mm	100	100	100	100
19.0 mm	--	--	95-100	95-100
9.5 mm	50-85	40-75	50-90	50-90
4.75 mm	35-65	25-60	35-70	35-70
2.00 mm	25-50	15-45	20-55	15-55
425 μm	10-30	--	10-35	--
75 μm	3-10*	3-12	8-15	5-15

B. Leveling course: Section 304 of standard specifications, crushed stone, Gradation No. 3, per the Table above.

C. Shoulder: Section 304 of standard specifications, crushed stone, Gradation No. 3 (traffic bond), the rest may be Gradation No. 2 or 3.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

A. Spread aggregate over prepared substrate to a total compacted thickness as shown on the Drawings.

B. Compact placed aggregate materials to achieve at least 95 percent of its maximum dry density in accordance with ASTM D698.

C. Level and contour surfaces to elevations and gradients indicated.

D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

G. Spread leveling coarse over crushed aggregate base coarse to a total compacted thickness as shown on the Drawings. Place and compact in the same manner as per the crushed aggregate base coarse.

H. Shoulder material shall be placed and compacted to a total thickness as shown on the Drawings, and in accordance with Sec. 304.5 of standard specifications.

3.4 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.

C. Maximum Variation From Thickness: 1/4 inch.

D. Maximum Variation From Elevation: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Gradation of Aggregate: In accordance with the Standard Specifications, Section 304.

C. Compaction testing will be performed in accordance with ASTM D2922 and ASTM D3017.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

END OF SECTION

SECTION 02750

RIGID PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete sidewalks and mow strips.
   2. Concrete stair steps.
   3. Concrete integral curbs and gutters.
   4. Concrete parking areas and approach slabs.

1.2 REFERENCES

A. State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction, 2016 Edition, with most recent Supplemental Specifications, hereinafter referred to as the Standard Specifications.

B. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

C. American Society for Testing and Materials:
   1. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
   2. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   3. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   4. ASTM C33 - Standard Specification for Concrete Aggregates.
   5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
   6. ASTM C150 - Standard Specification for Portland Cement.
   7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   8. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   9. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
   10. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   11. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit joint filler product information and mix design.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with requirements of the Standard Specifications.

B. Obtain cementitious materials from same source throughout.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Form Materials: As specified in Section 03100.

B. Joint Filler: ASTM D1751 resilient bituminous type; thickness as shown on the Drawings.

2.2 REINFORCEMENT

A. Reinforcing Steel and Wire Fabric: Type specified in Section 03200.

2.3 CONCRETE MATERIALS

A. Concrete Materials: As specified in Section 03300.

2.4 ACCESSORIES

A. Curing Compound: Liquid Membrane – Forming Compounds per Standard Specifications shall be used.

B. Joint Sealers: Specified in Section 07900.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify compacted subgrade and base course is acceptable and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

3.2 BASE COURSE

A. Aggregate Base Course: Install as specified in Section 02721.

3.3 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole, catch basin and imbedded frames with oil to prevent bond with concrete pavement.

C. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.

3.4 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

A. Place reinforcement at mid-height for sidewalks and mowstrips, top and bottom for concrete pavement and slabs-on-grade.

B. Interrupt reinforcement at expansion joints.

C. Place reinforcement to achieve pavement and curb alignment as detailed.

3.6 PLACING CONCRETE

A. Place concrete as specified in Section 03300.

3.7 JOINTS

A. Place contraction joints at same intervals as walk width. Align curb, gutter, and sidewalk joints.

B. Place joint filler between paving components and building or other appurtenances.

C. Provide joints between sidewalks and curbs, between curbs and pavement, and between pavement and structures as shown on the Drawings.

3.8 FINISHING

A. Area Paving: Light broom and trowel joint edges.

B. Sidewalk Paving: Light broom, and trowel joint edges.

C. Curbs and Gutters: Light broom.

D. Inclined Vehicular Ramps: Broomed perpendicular to slope.

E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.9 JOINT SEALING

A. Separate pavement from vertical surfaces with joint filler, ½ inch thick unless shown otherwise.

B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

C. Extend joint filler from bottom of pavement to within 1/8 inch of finished surface.

3.10 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.

C. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.

C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.12 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION

SECTION 02923

LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Final grade topsoil for finish landscaping.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures

B. Samples: Submit, in air-tight containers, 30 lb sample of topsoil fill to testing laboratory.

C. Analyze to ascertain percentage of nitrogen, phosphorous, potash, soluble salt content, organic matter content, and pH value.

D. Materials Source: Submit name of imported materials source.

PART 2 PRODUCTS

2.1 MATERIAL

A. Topsoil: From stockpile as specified in Section 02311.
   1. Excavated and reused material. Select.
   2. Graded and pulverized.
   3. Single screened, free of roots, rocks larger than ½ inch, subsoil, debris, large weeds and foreign matter.

B. Topsoil: Imported
   1. Imported borrow
   2. Natural, friable loam
   3. Single screened, reasonably free of roots, rocks larger than ½ inch, subsoil, debris, large weeds, and foreign matter.
   4. Acidity range (pH) of 5.5 to 7.5.
   5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify building and trench backfilling have been inspected.

C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

A. Protect landscaping and other features remaining as final Work. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

B. Prepare topsoil from stockpile by grading, pulverizing, and single screening onsite.

C. Substrate Preparation
1. Eliminate uneven areas and low spots.
2. Remove debris, roots, branches, and stones in excess of 1 inch in size. Remove contaminated subsoil.
3. Scarify surface to depth of 4 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.3 PLACING TOPSOIL

A. Place topsoil in areas where seeding, sodding, and planting, is required, to thickness as scheduled. Place topsoil during dry weather. Lightly compact placed topsoil. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade. Leave stockpile area and site clean and raked, ready to receive landscaping.

B. Manually spread topsoil close to plant material, buildings, and trees to prevent damage. Remove roots, weeds, rocks, and foreign material while spreading.

C. Remove surplus subsoil and topsoil from site.

3.4 TOLERANCES

A. Per Section 01400 - Quality Requirements: Tolerances.

B. Top of Topsoil: Plus or minus 1/2 inch.

3.5 PROTECTION OF INSTALLED WORK

A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.

B. Prohibit construction traffic over topsoil.

3.6 SCHEDULES

A. Compacted topsoil thicknesses:
1. Seeded Grass: 4 inches.
2. Sod: 4 inches.
3. Shrub Beds: 4 inches.
4. Landscape Berms: 4 inches.

END OF SECTION

SECTION 02924

SEEDING AND SOIL SUPPLEMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Seeding and Hydroseeding.
   2. Mulching.
   3. Soil testing and fertilizer.
   4. Maintenance.

1.2 REFERENCES

A. American Society for Testing and Materials:
   1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

1.3 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.

C. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.
   1. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.6 QUALITY ASSURANCE

A. All seed shall conform to the requirements of the Wisconsin Statutes and the Wisconsin Administrative Code Chapter ATPC 20 regarding noxious weed seed content and labeling.

B. Provide grass seed mixtures in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Deliver grass seed mixtures and prairie seed in sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

1.9 MAINTENANCE SERVICE

A. Section 01700 - Execution Requirements: Requirements for maintenance service.

B. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for two cuttings.

PART 2 PRODUCTS

2.1 SEED MIXTURES

A. Provide the following seed mixtures in accordance with schedule herein.

B. Seed Mixture 1 – Mixture No. 10 as described in Section 630 of the Standard Specifications for Highway and Structure Construction, current edition as published by the State of Wisconsin Department of Transportation.

2.2 SOIL MATERIALS

A. Topsoil: As specified in Section 02923.

2.3 ACCESSORIES

A. Mulching Material: Pennmulch Seed Accelerator with Starter Fertilizer shall be provided as mulch for seed mix #1. Dry oat, wheat straw or marsh hay, free from weeds and foreign matter detrimental to plant life are acceptable for seed mixes 2 and 3. Hay or chopped cornstalks are not acceptable.

B. Hydroseeding Mulch: Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content.

C. Tackifier: Arn-Tak manufactured by American Excelsion, or equal. Emulsion designed to retain moisture and heat in the soil. Mulch shall be chemically inert, nontoxic to plants, humans, and animals.

D. Fertilizer: FS O-F-241, Grade A; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis.

E. Lime: ASTM C602, Class T agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, if indicated in soil analysis.

F. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

G. Erosion Fabric: Interlocking wood fibers with biodegradable net backing, Curlex erosion control blanket.

H. Stakes: Softwood lumber, chisel pointed.

I. String: Inorganic fiber.

J. Edging: Galvanized steel.

2.4 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing, inspection and analysis requirements.

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

C. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.

D. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work

B. Verify prepared soil base is ready to receive the Work of this section. Refer especially to required conditions for seeding of prairie and No Mow Lawn Mix as specified by Prairie Nursery.

3.2 FERTILIZING

A. Apply lime and fertilizer at application rate recommended by soil analysis.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine used to apply seed.

D. Mix fertilizer thoroughly into upper 3 inches of topsoil.

E. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 METHOD

A. The areas to be seeded shall be worked with discs, harrows and other appropriate equipment until a reasonable even and loose bed is obtained immediately in advance of seeding.

B. The seed mixture shall be sown by means of equipment adapted for the purpose, or it may be scattered uniformly by hand and lightly raked or dragged over the area to cover the seed with approximately 6mm of soil.

C. After seeding the areas shall be lightly rolled or compacted by suitable equipment, if the in the judgment of the Landscape Architect, the seedbed is either too loose or contains clods which would reduce the germination of the seed.

3.4 SEEDING RATES

A. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

B. For seed mix #1, apply seed at rate of at least 4 lbs per 1000 sq.ft.; distribute evenly in two intersecting directions. Rake in lightly.

C. Immediately following seeding, apply mulch. Maintain clear of shrubs and trees. Do not seed areas in excess of that which can be mulched on same day.

D. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

E. Planting Season: May 1 to June 15; August 15 to October 1.

3.5 HYDROSEEDING

A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at specified rates evenly in one pass.

B. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.6 SEED PROTECTION

A. Identify seeded areas with stakes and string around area periphery. Set string height to 8 inches. Space stakes at 36 inches.

B. Cover seeded slopes where grade is 3 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

C. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

D. Secure outside edges and overlaps at 36 inch intervals with stakes.

E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.7 MAINTENANCE

A. Mow grass (seed mix #1) at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.

B. Neatly trim edges and hand clip where necessary. Roll surface to remove minor depressions or irregularities.

C. Use mulching mower leaving finely chopped clipping on the lawn. Do not let clippings lay in clumps.

D. Water regularly and uniformly during plant establishment to prevent soil and plants from drying out.

E. Control growth of weeds. Apply selective herbicides according to instructions on label on lawn areas only. Remedy any damage resulting from improper use of herbicides

F. Protect seeded areas with warning signs during maintenance period. Repair washouts, gullies and any damage from unauthorized traffic. Immediately reseed areas showing bare spots.

3.8 SEED SCHEDULE

A. Seed Mixture 1: All disturbed grass / lawn areas.

END OF SECTION

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SECTION 03100

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes formwork for cast-in place concrete, with shoring, bracing, and anchorage; openings for other work; form accessories; and form stripping.

1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
   2. ACI 301 - Specifications for Structural Concrete.
   3. ACI 318 - Building Code Requirements for Structural Concrete.
   4. ACI 347 - Guide to Formwork for Concrete.
   5. ACI 350 – Environmental Engineering Concrete Structures

B. American Forest and Paper Association:
   1. AF&PA - National Design Specifications for Wood Construction.

C. The Engineered Wood Association:
   1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

D. American Society for Testing and Materials:
   1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

E. West Coast Lumber Inspection Bureau:
   1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to applicable code requirements; resultant concrete to conform to required shape, line and dimension as indicated on the Drawings.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 350, 347, 301, and 318.

B. For wood products furnished for work of this Section, comply with applicable provisions of AF&PA National Design Specifications for Wood Construction.

1.5 QUALIFICATIONS

A. Design formwork under direct supervision of Professional Structural Engineer experienced in design of this Work and licensed in the State of the Project Location.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Products storage and handling requirements.

B. Deliver void forms and installation instructions in manufacturer's packaging.

C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

C. After formwork is placed, verify that there is sufficient concrete cover over the reinforcement. If there is insufficient concrete cover, request instructions from Architect/Engineer.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Plywood: Douglas fir or Spruce species; select sheathing, tight face grade; sound undamaged sheets with clean, true edges.

2.2 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes required.

2.3 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, fixed length, cone type, with waterproofing washer, 1 inch back break dimension, free of defects capable of leaving holes larger than 1-1/4 inch in concrete surface.

B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

C. Corners: Fillet or Chamfer, wood strip type; 3/4 inch x 3/4 inch.

D. Flashing Reglets: Rigid PVC, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

E. Vapor Retarder: Where shown on Drawings, 8 mil thick polyethylene sheet.

F. Joint Filler: As specified in Section 03251.

G. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

H. Water Stops: As specified in Section 03251

2.4 COATINGS

A. Coatings for Aluminum:
   1. Conlux:
      a. Primer: Bond Plex 46 or 66 (water-borne urethane).
      b. Top Coat: Epolon Multi-Mil 39 (epoxy polyamide).
   2. Sherwin Williams: Topcoat of Heavy Duty Epoxy B67-B60B3 (epoxy polyamide). Note: Self-priming.
   3. Benjamin Moore:
      a. Primer: Epoxy Rust-Inhibitive Primer (epoxy polyamide).
      b. Top Coat: Epoxy Enamel (epoxy polyamide).

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

3.2 EARTH FORMS

A. Earth forms are not permitted.

3.3 INSTALLATION

A. Formwork - General:
   1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
   2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
   3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
   4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
   5. Complete wedging and bracing before placing concrete.

B. Forms for "Smooth Finish" Concrete:
   1. Use steel, plywood or lined board forms.
   2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
   3. Install form lining with close-fitting square joints between separate sheets without springing into place.
   4. Use full size sheets of form lines and plywood wherever possible.
   5. Tape joints to prevent protrusions in concrete.
   6. Use care in forming and stripping wood forms to protect corners and edges.
   7. Level and continue horizontal joints.
   8. Keep wood forms wet until stripped.

C. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

D. Framing, Studding and Bracing:
   1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
   2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
   3. Construct beam soffits of material minimum of 2 inches thick.
   4. Distribute bracing loads over base area on which bracing is erected.
   5. When placed on ground, protect against undermining, settlement or accidental impact.

E. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

F. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

G. Obtain Architect/Engineer's approval before framing openings in structural members that are not indicated on Drawings.

H. Install fillet and chamfer strips on external corners of beams, columns, walls and slabs.

I. Install void forms in accordance with manufacturer's recommendations.

J. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer’s specifications. Do not coat forms for concrete indicated to receive “scored finish”. Apply form coatings before placing reinforcing steel.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

H. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.

4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true and sharp.

K. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Securely anchor embedded items in correct location and alignment prior to placing concrete.
4. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318, Section 6.3.

L. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where shown on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:
1. For concrete over waterproof membranes and vapor barrier membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

O. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris.

3.6 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

3.7 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.8 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads. Forming shall remain in place for at least the minimal time recommended by ACI 347R. In addition, forming for horizontal members such as elevated slabs and beams shall remain in place a minimum of 7 days. In no case shall forming of horizontal members be removed before the concrete has reached at least 70% of its specified design strength.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Reshore areas as required to carry additional imposed loads.

D. Repair damage to structure caused by early removal of forming and shoring at no additional cost to Owner.

E. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

F. See Section 03300 for additional requirements.

3.9 ERECTION TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

B. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances specified in ACI 117.

C. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes reinforcing steel bars, welded wire fabric and reinforcement accessories for cast-in-place concrete.

1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 318 - Building Code Requirements for Structural Concrete.
   3. ACI 350 – Environmental Engineering Concrete Structures
   4. ACI SP-66 - ACI Detailing Manual.

B. American Society for Testing and Materials:
   1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. A185/A185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   3. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   5. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   6.

C. American Welding Society:
   1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Concrete Reinforcing Steel Institute:
   1. CRSI - Manual of Standard Practice.
   2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

A. Section 01300 – Submittals: Procedure for Submittals.

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.
   1. Coordinate bar splicing and placement with CONTRACTOR'S concrete placing schedule and joint locations.
   2. Submit with construction joint submittals required in Section 03300.

C. Dowel bar splicer system, reinforcing bar splicer laboratory reports and manufacturer's product data.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI - Manual of Standard Practice.

B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Welders: AWS qualification within previous 12 months.

1.6 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars, unfinished.
   1. If reinforcement is to be welded, Deformed Reinforcement: ASTM A706/A706M; 60 ksi yield strength, steel bars, unfinished shall be used.

B. Welded Plain Wire Fabric: ASTM A185; in flat sheets; unfinished.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type or patented system.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic-coated steel or Stainless steel type; size and shape as required for Project conditions.

D. Dowel Bar Splicer: ASTM A615, 60 ksi deformed rebar material; the completed splice shall meet 125% specified yield stress. Use "Dowel Bar Splicer (DB-SAE) and Dowel-In (DI) manufactured by Dayton/Richmond or approved equal.

2.3 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice.

B. Fabricate column reinforcement with offset bends at reinforcement splices.

C. Weld reinforcement in accordance with AWS D1.4.

D. Locate reinforcement splices not indicated drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
   1. Do not weld crossing reinforcement bars for assembly except as permitted by Architect/Engineer.

B. Do not field bend bars, including bars partially embedded in concrete, unless indicated.

C. Do not place bars having kinks and bands other than shown on the Approved Shop Drawings.

D. Do not displace or damage vapor retarder.

E. Locate reinforcing to avoid interference with items drilled in later, such as concrete anchors.

F. Reinforcement shall be continuous through construction joints
   1. Reinforcement may be spliced at construction joints provided that the entire lap is placed within one concrete pour.

G. Extend welded wire fabric to within 2 inches of edges of slab or section. Lap sheets at least 12 inches or 2-wire spaces, whichever is greater at ends and edges and wire together. Stagger end laps.

H. Accommodate placement of formed openings.

I. Space reinforcement bars with minimum clear spacing of one bar diameter, but not less than 1 inch.
   1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.

J. Unless otherwise indicated on drawings, conform to ACI 350 for concrete cover over reinforcement.

K. Dowel bar splicer systems may be substituted for dowels at CONTRACTOR’s option when approved by Engineer.

L. Reinforcing bar splicers may be substituted for lapped splices at CONTRACTOR'S option when approved by engineer.

3.2 ERECTION TOLERANCES

A. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

3.3 FIELD QUALITY CONTROL

A. Section 01400 – Quality Control: Field inspection and testing.

END OF SECTION

SECTION 03251

CONSTRUCTION, EXPANSION AND CONTRACTION JOINTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Forming integral construction, contraction and control joints in concrete.

B. Visually concealing expansion joints in concrete.

1.2 REFERENCES

A. ANSI/ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type).

B. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

C. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. ASTM D638 - Standard Test Method for Tensile Properties of Plastics

E. ASTM D 746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

1.3 SUBMITTALS

A. Provide 6-inch long sample of expansion and contraction joint under provisions of Section 01300.

B. Provide 6-inch long sample of all cast-in type waterstops to be used on the Project under provisions of Section 01300.

C. Submit manufacturer's installation instructions under provisions of Section 01300.

1.4 QUALITY ASSURANCE

A. Pre-Concrete Placement Inspection
   1. All waterstop joints shall be subject to strict inspection. Waterstops that are damaged, not firmly secured, in the wrong location, or improperly spliced will be rejected.
   2. Notify Engineer a minimum of 24 hours prior to the commencement of concrete placement.
   3. Allow Engineer to inspect all waterstops before formwork is erected if the formwork will impede inspection.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store waterstops and joint materials under tarps and off of ground to protect from oil, dirt, water and sunlight.

PART 2 PRODUCTS

2.1 INTEGRAL JOINT MATERIALS

A. General: All materials shall be classified as acceptable for potable water use according to NSF Standard 61.

B. Ribbed with Center Bulb Waterstop: PVC, minimum 1750 psi tensile strength, low temperature brittleness minus 35 degrees F; flat profile; ribbed flaps; large center bulb; 4-inch, 6-inch or 9-inch wide. Style 701, 732 or 735 as manufactured by Greenstreak Plastics Products, or approved equal.
   1. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

C. Retro-Fit Waterstop: PVC, minimum 1750 psi tensile strength, low temperature brittleness minus 35 degrees F; Style 667, 609 or 581 as manufactured by Greenstreak Plastics Products, or approved equal.
   1. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

D. Labyrinth Profile Waterstop: PVC, minimum 1750 psi tensile strength, low temperature brittleness minus 35 degrees F; Style 790 or 789 as manufactured by Greenstreak Plastics Products, or approved equal.
   1. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

E. Pre-formed Hydrophyllic Waterstop: Hydrophyllic (bentonite-free) waterstops shall be Hydrotite CJ10202K as manufactured by Greenstreak Plastic Products Co., Sikaswell-S by Sika Corp, or approved equal.

F. Joint Filler: ANSI/ASTM D1752, Type 1, closed-cell neoprene, fully compressible with recovery rate of minimum 95 percent, as manufactured by W.R. Meadows or approved equal.

2.2 SEALANTS

A. Sealant and Primer: Specified in Section 07900.

PART 3 EXECUTION

3.1 INSTALLATION

A. Locate and form construction, expansion, control, and contraction joints.
   1. Unless otherwise noted, construction joints shown are optional. Joints not shown on Drawings shall be approved by Engineer.

2. Limit size of concrete pours. Maximum length of wall and slab pours shall not exceed 60 feet.
3. Locate construction joints in floors within the middle third of the span. Construction joints in floors supported by walls may be located at the center of wall with Engineer's approval.
4. Construction joints in beams shall be offset a minimum distance of 2 times the width of intersecting beams.
5. Locate vertical construction joints in walls a minimum of one-half the wall height from corners or other intersecting walls or at midpoint between corners orf intersecting walls. Locate horizontal joints in wall within middle third of wall height.
6. Make control joints in slabs on grade of preformed control joint strips set flush with finished surface, by construction joint, by tooled joint or cut a minimum 3/16" wide joint with a diamond saw within 12 hours after concrete placement.
    a. Cut alternate reinforcing bars or wires crossing joint
    b. Provide preformed control strip in full length unspliced pieces unless a special splice designed to prevent misalignment of splice joint is used.
    c. Control joints shall be ¼ depth of slab, unless shown otherwise on Drawings.
    d. Fill construction joint, tooled joint and sawed joints with epoxy joint filler.

B. Provide waterstop in construction joints in:
1. Walls and slabs separating dry interior from earth or liquid.
2. Exterior walls of liquid holding tanks
3. Floor slabs above occupied areas
4. Other locations shown on the Drawings.

C. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight.
1. Tie plastic waterstop to reinforcing steel at 24 inches on center with a minimum 16 gage tie wire to prevent movement when placing concrete. When waterstop is to be formed into the formwork the plastic waterstop shall be secured to the form work to prevent movement. "Mucking" or setting waterstop into wet concrete after concrete placement will not be allowed.

D. Use Hydrophyllic waterstops only where noted on Drawings. Fasten, nail, or screw and apply per manufacturers recommendations.

E. Place formed construction joints in floor slab and walls to facilitate pattern placement sequence. Set top screed to required elevations for floor slabs. Secure to resist movement of wet concrete.

F. Install joint fillers and sealants in accordance with manufacturer's instructions. Use primers of type recommended by joint filler and sealant manufacturer.

G. Apply sealants in accordance with Section 07900.

END OF SECTION

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place structural concrete, fill concrete, building frame members, floors, shear walls, foundation walls, and supported slabs.

B. Floors and slabs on grade.

C. Equipment pads, light pole bases, thrust blocks, and miscellaneous concrete work.

D. Non-shrink grout, high precision grout, patching mortar, and grout for clarifier floor.

E. Control, expansion and contraction joint devices.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 305 - Hot Weather Concreting.
4. ACI 306.1 - Standard Specification for Cold Weather Concreting.
5. ACI 318 - Building Code Requirements for Structural Concrete.
6. ACI 350 - Environmental Engineering Concrete Structures.

B. American Society for Testing and Materials:
1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
5. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
8. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
9. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
10. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
11. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
12. ASTM C595 - Standard Specification for Blended Hydraulic Cements.

13. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
14. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
15. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
16. ASTM 1077 - Practice for Laboratories Testing Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
17. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
18. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
19. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
20. ASTM D2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
21. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
22. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
23. ASTM E1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on attachment accessories, admixtures, non-shrink grout and high precision grout, patching mortar and accessories.

C. Furnish submittals in accordance with ACI 301 including mill tests for cement, admixture certification (including chloride ion content), aggregate gradation test results and certification, materials and methods for curing, quality-control program of the concrete supplier.

D. Design Data:
1. Submit concrete mix design for each concrete strength to be used on the project. Submit separate mix designs when admixtures are required for the following:
   a. Hot and cold weather concrete work.
   b. Air entrained concrete work.
2. Identify mix ingredients and proportions, including admixtures.
3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

E. Delivery Tickets: When ready mixed concrete is used, the Contractor shall furnish delivery tickets, with the information stated in Sections 15.1 and 15.2.8 of ASTM C94, with each batch of concrete before unloading at the site. Recording of revolution counter is required.

F. Product Data: Submit data on joint devices, attachment accessories, admixtures, non-shrink grout and high precision grout, patching mortar and accessories.
   1. High Range Water Reducer: Submit intended use area with product data and mix design.

G. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

H. Provide test data on fly ash for each truck load of fly ash delivered for use on this project, conforming to ASTM C618, including the requirements of Tables 1 through 3 and optional requirements.

I. Construction Joints: Sequence of placing concrete, location and details of joints, openings and embedded items not shown on Drawings. Coordinate sequence of placement and joint locations with reinforcement Shop Drawings. Submit reinforcement submittals as required in Section 03200.

J. Control Joints in slabs-on-grade: Locations and details of joints.

K. Test Results:
   1. Concrete test results.
   2. With each load of concrete delivered, provide duplicate delivery tickets, one for CONTRACTOR and one for ENGINEER, with the following information.
      a. Date and serial number of ticket.
      b. Name of ready mixed concrete plant, operator, and job location.
      c. Type of cement, admixtures, if any, and brand name.
      d. Cement content, in bags/cu yd of concrete, and mix design.
      e. Truck number, time loaded, and name of dispatcher.
      f. Amount of concrete in load, cu yds, delivered.
      g. Maximum size aggregate.
      h. Gallons of water added at job, if any, and slump of concrete after water was added.
      i. Temperature of concrete at delivery.
      j. Time unloaded.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Perform Work in accordance with the standards of the State in which the project is located.

C. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards

material storage and handling, catching equipment, central mixer, truck mixers with counters, agitators, non-agitating units, and ticketing system.

D. Concrete Testing: Testing shall be provided by CONTRACTOR in accordance with Section 01400 and this section.
   1. Test concrete and sample material in accordance with applicable ASTM methods listed below.
      a. Slump: ASTM C143.
      b. Air-Entrainment: ASTM C231.
      c. Compressive Strength Test: ASTM C31 (making and cylinder curing) and ASTM C39 (testing)

E. Approved of use of high range water reducer and non-chloride accelerator shall be used in accordance with manufacturer's recommended dosage range.

F. Evaluation and Acceptance of Concrete Strength:
   1. Evaluation and acceptance of concrete shall be according to ACI 318, Chapter 5 and as indicated herein.
   2. Analysis of compression test results shall be performed according to methods in ACI 214. Overall standard deviation of the test results shall not exceed 600 psi.

G. Acceptance of Structure:
   1. All concrete which does not meet the requirements, including strength, dimensional tolerances, appearance, durability of ACI 301 and these specifications is subject to removal at no cost to the Owner.
   2. Concrete members cast in the wrong location may be rejected.
   3. Formed surfaces resulting in concrete outlines that are smaller or larger than permitted by the tolerances of ACI 117 may be rejected.

H. Hot Weather:
   1. Comply with ACI 305
   2. Concrete temperature shall not exceed 90° F
   3. At air temperatures of 80° F or above, keep concrete as cool as possible during placement and curing.
   4. When concrete temperatures are expected to exceed 80° F during curing, water reducing, set retarding admixtures shall be used in accordance with manufacturer's recommendations.

I. Cold Weather:
   1. Comply with ACI 306.1
   2. Temperature of reinforcement, forms, fillers, and other materials in contact with concrete at time of placement shall not be less than 35° F. Preheat if temperature is below 35° F.
   3. Maintain air and forms in contact with concrete sections having a minimum dimension of 12 inches or less at temperatures above 50° F for at least the first three days and at a temperatures above 32° F for the remainder of specified curing period
   4. Maintain air and forms in contact with concrete in more massive sections at temperatures above 40° F for at least the first three days and at temperatures above 32° F for the remainder of specified curing period

1.6 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement for all hydraulic and below grade structures and sewers: ASTM C150, Type I - Portland type with Fly Ash or Slag or Type II - Moderate Sulfate Resistant.

B. Cement for non-hydraulic and above grade structures: ASTM C150, Type I or Type II - Moderate Sulfate Resistance, Portland type.

C. Fine and Coarse Aggregates: ASTM C33.

D. Normal Weight Aggregates: ASTM C33.
   1. Coarse Aggregate Maximum Size: 1 1/2 inches in accordance with ACI 318.

E. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260; Daravair by W.R. Grace; MicroAir by Master Builders; Sika AEA-15 by Sika Corp; or approved equal.

B. Chemical: ASTM C494
   1. Type A - Water Reducing; WRDA with Hycol or WRDA-82 manufactured by W.R. Grace or approved equal.
   2. Type D - Water Reducing and Retarding; Daratard-17 manufactured by W.R. Grace or approved equal.
   3. Type F (or G) - Water Reducing, High Range; Daracem-100 manufactured by W.R. Grace; WRDA-19 manufactured by W.R. Grace; or approved equal.

C. Fly Ash: ASTM C618; Class C or Class F providing increased sulfate resistance equivalent to or better than Type II cement.

D. Slag: ASTM C989; Grade 120; ground granulated blast furnace slag.

E. Integral Corrosion Inhibitor: ASTM C494 Type C admixture that chemically inhibits the corrosive action of chlorides on reinforcing steel. DCI Corrosion Inhibitor by W.R. Grace, Polychem CI by General Resource Technology, Inc. or approved equal. Dosage rate shall be as recommended by supplier.

F. Integral waterproofing admixture: Hydrophilic, crystalline admixture for waterproofing concrete. Admix C-500 by Xypex; Penetron by W.R. Grace; Kystol Internal Membrane by Kryton; ADI-CON Plus by W.R. Meadows; or Hycrete W500 by Hycrete, Inc.; or

Approved equal. Add admixture to concrete in accordance with manufacturer's recommendations.

G. Synthetic Macro Fiber Reinforcement: ASTM C1116. High modulus synthetic macro fiber reinforcement that evenly distributes through concrete mix. Strux 90/40 by Grace Construction Products, Fibermesh 650 by Propex Global; Tuf-Strand SF by Euclid Chemical Company or approved equal. Apply fiber reinforcement to concrete mix to provide a minimum of 4 lbs per cubic yard, unless noted otherwise.

2.3 ACCESSORIES

A. Epoxy Bonding Agent:
   1. Non-sag type: Concressive Paste (SPL or LPL) by Master Builder, Sikadur 32 Hi-Mod Gel Epoxy Adhesive by Sika Corp; or approved equal.
   2. Liquid Type: Concressive Liquid (LPL) by Master Builders; Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corp; or approved equal.

B. Vapor Retarder: As specified in in Section 03100.

C. Non-Shrink Grout: For steel column base plates and machine bases under 10 hp. ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 3,000 psi in 72 hours and 7,000 psi in 28 days.

D. High Precision Grout: For machine bases over 10 hp. Premixed compound consisting of metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 72 hours and 9,000 psi in 28 days; EMBECO 850 Grout manufactured by Master Builders or approved equal.

E. Concrete repair mortars: One component, polymer-modified, cementitious patching material. SikaRepair 222/223 by Sika Corporation; MasterEmaco S440 by BASF Corporation Construction Systems; Planitop 18 by Mapei Corporation, Patchcrete by Lyons Manufacturing, Inc. or approved equal.

F. Surface Applied Corrosion Inhibitor: Surface applied, impregnating coating for steel reinforced hardened concrete. Shall protect both anodic and cathodic parts of the corrosion cell. Sika FerroGard 903 by Sika Corporation; Mapeshield CI 100 by Mapei Corporation or approved equal.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler, Waterstops: As specified in Section 03251.

B. Sealant and Primer: As specified in Section 07900.

2.5 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94, Option C.
   1. Deliver and complete discharge within 1 ½ hours of commencing of mixing or before 300 revolutions of drum or blades, whichever comes first. This includes revolutions required by transit mix trucks. Limitations may be waived by

Engineer if the concrete slump is within the allowable range, after the 1 ½ hours or the 300 revolutions limit is reached, and concrete can be placed without addition of water. In hot weather, time and/or revolutions criteria may be reduced by Engineer.

2. Do not add water on-site unless slump and water-cement ratio, after addition of water, are below the maximums allowed. If water is added on-site, mix concrete at site an additional 30 revolutions.
3. Deliver concrete to site having a temperature not less than 50 degrees F nor greater than 90 degrees F.
4. If high range water-reducing admixture is added on-site, mix concrete at site an additional 85 revolutions of drum after the addition of high range water-reducing admixture.

B. Select proportions for normal weight concrete in accordance with ACI 301 trial mixtures.

C. Provide STRUCTURAL concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,800 psi
Compressive Strength (28 day)	4,000 psi
Water/Cement (fly ash) Ratio (maximum)	0.45 by weight
Cement plus fly ash (minimum)	525 lb/cubic yard
Aggregate Size (maximum)	1 inch
Air Entrained	4 to 6 percent
Admixture	Water reducing type
Slump	2 to 5 inches

D. Sides and bottoms of liquid containing structures such as tanks, clarifiers, wells, etc, provide concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,800 psi
Compressive Strength (28 day)	4,500 psi

Water/Cement (slag) Ratio (maximum)	0.42 by weight
Cement plus slag (minimum)	600 lb/cubic yard
Aggregate Size (maximum)	1 inch
Air Entrained	4 to 6 percent
Admixtures	Water reducing type Intergral Waterproofing
Slump	2 to 5 inches

E. Miscellaneous concrete and exterior slabs provide concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,000 psi
Compressive Strength (28 day)	3,000 psi
Water/Cement (slag) Ratio (maximum)	0.49 by weight
Cement plus slag (minimum)	475 lb/cubic yard
Aggregate Size (maximum)	1½ inch
Air Entrained	4 to 6 percent
Admixtures	Water reducing type Macro Fiber Reinforcement 4 lbs/c.y.
Slump	3 to 6 inches

F. Concrete topping slabs or slab-on-metal deck provide concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,800 psi
Compressive Strength (28 day)	4,000 psi
Water/Cement (slag) Ratio (maximum)	0.45 by weight

Cement plus slag (minimum)	515 lb/cubic yard
Aggregate Size (maximum)	¾" inch
Air Entrained	4 to 6 percent
Admixture	Water reducing type Macro Fiber Reinforcement 5 lbs/C.Y.
Slump	3 to 6 inches

G. Provide FILL concrete to the following criteria:

Unit	Measurement
Compressive Strength (28 day)	3,000 psi

H. Use accelerating admixtures in cold weather only when approved. Use of admixtures will not relax cold weather placement requirements.

I. Use calcium chloride only when approved by the Engineer.

J. Use set retarding admixtures during hot weather only when approved by the Engineer.

K. Add air entraining agent to normal weight concrete exposed to exterior. On surfaces to receive non-metallic hardener limit air content to 3% or less.

L. Concrete for soil backfill or utility backfill shall be Cementitious Controlled Low-Strength Material as specified in section 03320.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, clean holes, insert and grout steel dowels using epoxy bonding agent. Prepare holes and use bonding agent in accordance with Manufacturer's instructions.

C. Slope subgrade to floor drains to maintain the minimum slab thicknesses dimensioned on the Drawings.

D. Pitch slab and beam forms to match top slope of slab or beam to maintain thickness or depth noted on Drawings. As an alternate, the bottom of the slab or beam may be poured level provided that the minimum thickness or depth is maintained.

E. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

F. Remove debris and ice from formwork, reinforcement and concrete substrates.

G. Subgrade and bedding shall be compacted and free of frost. If placement is allowed at temperatures below freezing, provide temporary heat and protection to remove frost. Do not place concrete on frozen material.

H. Soak subgrade the evening before concrete placement and sprinkle ahead of placement of concrete.

I. Remove standing water, ice, mud and foreign matter before concrete is deposited.

J. Place joints in accordance with Section 03251.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 301, ACI 318, and ACI 304.

B. Notify Architect/Engineer a minimum 24 hours prior to commencement of concrete placement operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
   1. Cast pipe and other embedded items into concrete as placement progresses. Do not provide block outs unless approved by Engineer.

D. Do not place ducts, conduits, pipes in slabs on grade. Place a minimum of 4 inches below bottom of slab.

E. Install vapor retarder under on-grade building floor slabs of occupiable (non-hydraulic) structures and at other locations indicated. Lap joints minimum 6 inches and seal watertight by sealant applied between overlapping edges and ends.

F. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor barrier material; lap over damaged areas minimum 6 inches and seal watertight in accordance with ASTM E1643.

G. Separate slabs on grade from existing vertical surfaces with a 1/2 inch thick joint filler.

H. Place joint filler in floor slab as required by the sequence of placement. Set top to required elevations. Secure to resist movement by wet concrete.

I. Extend joint filler from bottom of slab to within a ½ inch of the finished slab surface. Conform to Section 07900 for finish and joint sealer requirements.

J. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

K. Place concrete continuously between predetermined expansion, control, and construction joints.
   1. Place in lifts not exceeding 24 inches and compact with an internal mechanical vibrator
   2. Do not spread concrete with vibrators.

L. Do not interrupt successive placement; do not permit cold joints to occur.

M. Place floor slabs in long strips as illustrated in ACI 302 where possible.

N. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.

O. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 inch in 10 ft. Slope to floor drains where applicable.

P. The maximum free drop of concrete, where reinforcing will cause segregation of mix, allowed:
   1. Superplasticized Concrete: 10 ft maximum drop
   2. Other concrete 5 ft maximum drop

Q. Pitch floor to floor drains with a minimum slope of 1/8 inch per foot or as shown on the Drawings.

R. Apply sealants to joints in accordance with Section 07900.

3.4 SEPARATE FLOOR TOPPINGS

A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.

B. Place required reinforcing and other items to be cast in.

C. Apply bonding agent to substrate in accordance with Manufacturer's instructions.

D. Place concrete floor toppings to required lines and levels.

E. Screed toppings level, maintaining surface flatness.

3.5 CONCRETE FINISHING

A. Finish concrete floor surfaces in accordance with Section 03346.

B. Rough Form Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water, wastewater or subsequent construction.
   1. Patch honeycombing, stone pockets, form ties, spalls and other irregularities as specified in this section and cure.
   2. Where joint marks or fins on submerged surfaces exceed ¼ inch, grind smooth

C. Smooth Form Finish: Interior concrete surfaces permanently exposed to view, interior surface of tanks exposed to view extending 6 inches below liquid level and concrete surfaces scheduled to be painted.
   1. After removal of forms, patch or point up defects as specified and cure
   2. Grind joint marks and fins smooth with adjacent surface. Remove oil stains and rinse surface.
   3. After grinding and cleaning, dampen concrete and paint entire surface with cement grout. Work cement grout into surface with cork or other suitable float. When grout has set to where it will not be pulled out of holes or depressions, brush off surface with dry burlap or carpet.
   4. Prepare surfaces to be painted in accordance with Section 09900 and paint manufacturer's requirements.

D. Rubbed Form Finish: Exterior cast-in-place concrete surfaces permanently exposed to view extending to 6 inch below finish grade or liquid level, unless otherwise indicated on Drawings.
   1. After removal of forms, patch or point up defects as specified and cure.
   2. Remove joint marks, fins, and stains as described for smooth finish,
   3. Apply heavy coat of finishing grout. After the first coat has set, apply a second coat. When the second coat has set, float to uniform texture.
   4. Follow manufacturer's written instructions for finishing concrete.
   5. Finish color shall be gray.

E. Prepare surfaces which have other materials applied in accordance with requirements specified in other Sections.

3.6 CURING AND PROTECTION

A. Cure concrete surfaces in accordance with Section 03370.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.7 SCREED FINISH ON CLARIFIER SLABS

A. The purpose of the grout topping is to provide a smooth, even surface for the clarifier equipment operation. Place the grout topping on the floor of the clarifier tank after the equipment for the tank has been completely installed and works.

B. Remove all laitance from the surface of the concrete with a sand blast or water blast and thoroughly work and clean the surface. Keep the concrete base constantly wet for 24

hours, remove standing water and free moisture, and then hand sweep with a thick cement-water slurry mixture before placing the grout topping.

C. Mix proportions for the grout topping will be as specified in 2.3.E. Mix the grout in a concrete plant to a thick, creamy consistency so it can easily be screeded, but not so thin that it will not stand to the required thickness. Place grout in conformance with the clarifier equipment Manufacturer's instructions.

D. The grout in each clarifier will be placed without cold joints and will extend from the outside wall to the center of the basin. Use the clarifier equipment as a guide to accurately shape the grout. Do not use the mechanism to push or form the grout.

E. Keep the topping damp by using a hose with fine mist spray to prevent premature drying. When the grout topping is sufficiently hard, fill the tank with water to a level adequate enough to keep the entire floor covered. Keep floor submerged for seven days.

3.8 PATCHING

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections and repair defective areas in accordance with ACI 301. Use a non-shrink nonmetallic grout.

D. Obtain Engineer's approval of proposed repair techniques and mixes.

3.9 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Architect/Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

3.10 FIELD QUALITY CONTROL

A. Obtain samples of concrete in accordance with ASTM C172. Transport cylinders to an on-site location where they can be stored under conditions affecting concrete they represent without being disturbed for first 24 hrs.

B. Make slump tests daily and when requested by ENGINEER, in accordance with ASTM C143. Make slump tests from same batch from which strength tests are made.

C. When air-entrained concrete is used, make air content tests daily and when requested by ENGINEER in accordance with ASTM C231.

D. If measured slump or air content falls outside limits-specified, make check test immediately on another portion of same sample. In event of second failure, concrete shall be considered to have failed to meet requirements of Specifications and will be rejected.

E. Strength test for each class of concrete consists of 4 cured standard cylinders made from composite samples secured from single load of concrete in accordance with ASTM C172. Make compressive strength tests on 1 cylinder at 7 days and 2 cylinders at 28 days. Test results at 28 days shall be average strength of specimens as determined in accordance with ASTM C39. If specimen in test shows manifest evidence of improper sampling, molding or testing, it will be disregarded. Test remaining cylinder if needed.

F. Make strength test for each following condition for each class of concrete.
1. Each day's pour.
2. Each change of source.
3. Each 100 cu yds of concrete poured.
4. When temperatures are below or are expected to fall below 45°F within 48 hrs after concrete is placed, make 2 additional cylinders and cure in field under conditions approximating the conditions affecting the concrete they represent. Test one at 7 days, the other at 28 days.

G. Strength level of individual class of concrete is considered satisfactory if the following requirements are met.
1. Average of all sets of 3 consecutive strength tests equal or exceed the specified 28 day compressive strength.
2. No individual strength test falls below the specified 28 day compressive strength by more than 500 psi

H. If analysis of strength tests indicates above requirements are not being met, make immediate adjustments to the mix. Also, if likelihood of low strength concrete is confirmed, make additional tests as required by ENGINEER to determine the strength of the concrete in-place in the portion of the structure identified with the deficient cylinders. If tests and analysis verify Work in-place is not in conformance with Specifications, ENGINEER will determine whether or not Work in-place is adequate for the intended use the location. If Work is determined inadequate, CONTRACTOR shall follow such remedial or replacement measures which ENGINEER may require. CONTRACTOR shall bear costs in connection with testing, engineering analysis, remedial work, and replacements required under terms of this paragraph.

END OF SECTION

SECTION 03320

CEMENTITIOUS CONTROLLED LOW-STRENGTH MATERIAL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes Controlled Low-Strength Material (CLSM), Lean Concrete Fill, Flowable Fill, or Controlled Density Fill for filling excavations in soil, voids in soil, and below structures.

1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 229 - Controlled Low-Strength Materials

B. American Society for Testing and Materials:
   1. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
   2. ASTM C33 - Standard Specification for Concrete Aggregates.
   3. ASTM C40 - Test Method for Organic Impurities In Fine Aggregates for Concrete.
   4. ASTM C150 - Standard Specification for Portland Cement.
   5. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
   6. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
   7. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
   8. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
   9. ASTM 1077 - Practice for Laboratories Testing Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
   10. ASTM D5971 – Sampling Freshly Mixed Controlled Low Strength Material.
   11. ASTM D6103 – Flow Consistency of Controlled Low Strength Material.
   12. ASTM D6023 – Unit Weight, Yield, Cement Content and Air Content of Controlled Low Strength Material.
   13. ASTM D6024 – Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Furnish submittals including mill tests for cement, admixture certification, aggregate gradation test results and certification, and quality-control program of the material supplier.

C. Design Data:
   1. Submit mix design for each controlled low strength material to be used on the project.

2. Identify mix ingredients and proportions, including admixtures.

D. Provide test data on fly ash for each truck load of fly ash delivered for use on this project, conforming to ASTM C618, including the requirements of Tables 1 through 3 and optional requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Perform Work in accordance with the standards of the State in which the project is located.

C. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards material storage and handling, catching equipment, central mixer, truck mixers with counters, agitators, non-agitating units, and ticketing system.

D. Testing: Testing shall be provided by CONTRACTOR in accordance with Section 01400 and this section.
1. Test CLSM and sample material in accordance with applicable ASTM methods listed below.
a. Flow Consistency: ASTM D6103.
b. Unit Weight, Yield, and Air Content: ASTM D6023.
c. Ball Drop: ASTM D6024.

E. Approved of use of high range water reducer and non-chloride accelerator shall be used in accordance with manufacturer’s recommended dosage range.

1.6 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

PART 2 PRODUCTS

2.1 CONTROLLED LOW STRENGTH FILL MATERIALS

A. Cement for all hydraulic and below grade structures and sewers: ASTM C150, Type I - Portland type with Fly Ash or Slag or Type II - Moderate Sulfate Resistant.

B. Fly Ash: ASTM C618; Class C or Class.

C. Slag: ASTM C989; Grade 120; ground granulated blast furnace slag.

D. Fine Aggregates: ASTM C33.

E. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260; Daravair by W.R. Grace; MicroAir by Master Builders; Sika AEA-15 by Sika Corp; or approved equal.

B. Chemical: Darafill by W.R. Grace may be required to achieve proper flow and consolidation.

2.3 CONTROLLED LOW STRENGTH FILL MIX

A. Material shall consist of a flowable, self-consolidating, self-leveling mixture of aggregate, cementitous

B. Mix and deliver material in accordance with the following:

C. Hand Excavatable, maximum unconfined 28 day compressive strength of 30 psi to 50 psi.

D. Machine Excavatable: maximum unconfined 28 day compressive strength of 50 psi to 200 psi.

Non-Excavatable; maximum unconfined 28 day compressive strength of 200 psi to 1,000 psi.

E. Material shall have a maximum unit weight of 115 pcf to 145 pcf.

F. Material shall have an in-place yield of at least 98% of design yield.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

3.2 PREPARATION

A. Remove organic debris and ice from excavation to be filled.

B. Soak subgrade the evening before placement and sprinkle ahead of placement of material.

C. Remove ice, mud and foreign matter before material is deposited. Material may be placed in excavation with standing water.

D. Do not place material on frozen ground or when temperature is below 35 degrees and expected to drop.

3.3 PLACING CONTROLLED LOW STRENGTH MATERIAL

A. Notify Architect/Engineer a minimum 24 hours prior to commencement of placement operations.

B. Material shall be placed in lifts or other measures shall be used to prevent flotation of pipes or ducts located within fill material.

C. Maintain records of material placement. Record date, location, quantity, air temperature, and test samples taken.

D. Place material continuously for each lift of material placed. If entire excavation is to be filled, place such at material is allowed to become level prior to setting.

E. The maximum free drop of material shall not exceed 10 foot drop.

F. Screed material level if required, maintaining surface flatness.

G. Immediately after placement, protect filled area for accidental entry or backfill from other excavation work until material has hardened such to support applied weight.

H. Protect exposed surface of material from rain or running water.

3.4 FIELD QUALITY CONTROL

A. Obtain samples of material in accordance with ASTM D5971.

B. Perform Flowability tests in accordance with ASTM D6103.

END OF SECTION

SECTION 03346

CONCRETE FINISHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finishing slabs on grade, monolithic floor slabs and floor toppings.

B. Surface treatment with concrete hardeners, sealers, and slip resistant coatings.

1.2 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 302 - Guide for Concrete Floor and Slab Construction.

C. ACI 117-06 – Specification for Tolerances for Concrete Construction and Materials

D. ASTM C309 - Liquid Membrane-Forming compounds for Curing Concrete modified to meet the lower moisture loss requirements of FS TT-C800a or CRD-C 30-77.

E. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

F. ASTM E1155 - Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide data on concrete hardeners and sealers, curing compounds, and slip resistant treatment.

1.4 MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 302.

B. Maintain one copy of each document on site.

C. Applicators: Skilled applicators specializing in concrete surface treatments with a minimum three years documented experience and approved and certified by material manufacturers.

1.6 SAMPLE REFERENCE PANELS

A. Provide sample panels of floor finishes under the provisions of Section 01400.

B. Construct sample panels under conditions similar to those which will exist during actual placing, minimum 2 feet long by 2 feet wide, with coatings applied.

C. Locate where directed by Owner.

D. When accepted, sample reference panels will demonstrate minimum standard for the Work. Panels may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01600.

B. Deliver materials in manufacturer's packaging including application instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Temporary Lighting: Minimum 200 W light source placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.

B. Temporary Heat: Ambient temperature of 50 degrees F minimum.

C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.9 COORDINATION

A. Coordinate work under provisions of Division 1.

B. Coordinate the work with concrete floor placement and concrete floor curing.

PART 2 PRODUCTS

2.1 HARDENERS AND SEALERS

A. All materials shall be classified as acceptable for potable water use according to NSF Standard 61.

B. Floor Sealer: ASTM C309-Type 1-D cure and seal type;
1. Kure-N-Seal by Sonneborn
2. Cure and Seal by Symons
3. Approved equal.

C. Clear Floor Hardeners: Magnesium fluorosilicate and zinc fluorosilicate blend liquid type.
   1. Flouhard by L&M Construction Chemicals, Inc.
   2. Lapidolith by Sonneborn
   3. Approved equal

D. Membrane Forming Curing Compounds: see Section 03370

2.2 SLIP RESISTANT TREATMENT

A. Slip Resistant Finish: Aluminum oxide type, color as selected from Manufacturer's standard range.

2.3 EPOXY FLOOR FINISH

A. See Division 9.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

B. Verify that floor surfaces are acceptable to receive the Work of this Section.

3.2 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.

B. Wood float surfaces which will receive quarry tile, and ceramic tile with full bed setting system.

C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set ceramic tile, thin set terrazzo and thin set quarry tile.

D. Steel trowel surfaces twice (two trowelings) which are scheduled to be exposed.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 inch per foot nominal or as indicated on Drawings.

3.3 FLOOR SURFACE TREATMENT

A. Apply slip resistant finish in accordance with manufacturer's instructions as scheduled on floor and stair surfaces.

B. Broom Finish: Float and immediately light broom finish with soft bristled push broom to for all exterior slabs. Trowel once and light broom finish interior stairs and ramps, and per the room finish schedule. Broom at right angles to direction of traffic.

C. Clear Floor Hardener: Apply according to manufacturer's written instructions where shown on the room finish schedule.

D. Floor Sealer:
   1. Apply in accordance with manufacturer's written instructions
   2. Apply first coat after final troweling, surface water glaze has dissipated, and when shown on the room finish schedule
   3. Clean floor and apply second coat after Work is complete and building is ready for occupancy.

3.4 TOLERANCES

A. Measure for FF (Floor Flatness) and FL (Floor Levelness) tolerances for floor in accordance with ASTM E1155, within 48 hours after slab installation.

B. Finish concrete to achieve the following tolerances:
   1. Under Quarry Tile on Setting Bed: FF 35 and FL 20.
   2. Under Resilient Finishes: FF 60 under FL 40.
   3. Exposed to View and Foot Traffic: FF 60 and FL 40.

C. Correct the slab surface if the actual FF or FL number for the floor installation measures less than required.

D. Correct defects in the defined traffic floor by grinding or removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

END OF SECTION

SECTION 03370

CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Initial and final curing of horizontal and vertical concrete surfaces.

1.2 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.

C. ACI 308 - Standard Practice for Curing Concrete.

D. ACI 350 – Environmental Engineering Concrete Structures.

E. ASTM C156 - Water Retention by Concrete Curing Materials.

F. ASTM C171 - Sheet Materials for Curing Concrete.

G. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete modified to meet the lower moisture loss requirements of FS TT-C800a or CRD-C300-77.

H. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

I. ASTM D2103 - Polyethylene Film and Sheeting.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide data on curing compounds, mats, paper, film, rate of coverage, compatibilities and limitations.

C. Certification: Curing compound manufacturer shall certify their product, stating the product's effectiveness for the proposed application.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, ACI 302, ACI 308 and ACI 350.

B. Maintain one copy of each document on site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products under provisions of Section 01600.

B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. All materials shall be classified as acceptable for potable water use according to NSF Standard 61.

B. Materials for curing concrete as indicated herein shall conform to the following requirements and ASTM C 309
   1. Interior Concrete: Type 1-D – Clear or transparent with fugitive dye, compatible with scheduled finishes and coatings.
   2. Exterior Concrete: Type 2 – White pigmented.

C. Membrane Forming Curing Compounds: Interior Use
   1. Kure and Seal 30 by BASF
   2. Kurez DR Vox by The Euclid Chemical Company
   3. Approved Equal

D. Membrane Forming Curing Compounds: Interior Use – Water based resin curing compounds shall be used only where local air quality regulations prohibit use of solvent based compounds.
   1. Aqua Cure by The Euclid Chemical Company
   2. Cure R by L&M Construction Chemicals, Inc.
   3. Approved Equal

E. Membrane Forming Curing Compounds: Exterior Use
   1. Cure R-2 by L&M Construction Chemicals, Inc.
   2. Kurez Vox White Pigmented by the Euclid Chemical Company
   3. Approved Equal

F. Absorptive Mats: ASTM C171, burlap-polyethylene, minimum 9 oz/sq yd bonded to prevent separation during handling and placing.

G. Polyethylene Film: ASTM C171, 6 mil thick, white; ASTM C156 loss of moisture less than 0.055 grams per square centimeter of surface.

H. Water: Potable and not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate conditions.

B. Verify that substrate surfaces are ready to be cured.

C. Do not use curing compound on surfaces that are to receive additional concrete, paint, or tile, etc. that requires a positive bond, unless it can be demonstrated that the membrane can be satisfactorily removed before the subsequent application, or that the membrane can serve as a base for the later application. Otherwise use water curing.

3.2 EXECUTION - HORIZONTAL SURFACES

A. Cure floor surfaces in accordance with ACI 308 using one of the following methods:
   1. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 4 days.
   2. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
   3. Absorptive Mat: Saturate burlap-polyethylene mat and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 7 days.
   4. Membrane Curing Compound: Apply curing compound in accordance with manufacturer's instructions in 2 coats with second coat at right angles to first. Do not use curing compound where sealer, epoxy, mortar bed, grout, additional concrete or other coatings will be applied.
   5. Polyethylene Film: Spread over floor slab areas, lap edges and sides, seal with pressure sensitive tape; maintain in place for 7 days.

3.3 EXECUTION - VERTICAL SURFACES

A. Cure surfaces in accordance with ACI 308 using one of the following methods:
   1. Spraying: Continuously spray water over surfaces and maintain wet for 7 days.
   2. Membrane Curing Compound: Apply curing compound, immediately after removal of forms, in accordance with manufacturer's instructions in 2 coats with second coat at right angles to first.
   3. Leave concrete forms in place and keep sufficiently damp at all times to prevent opening of the joints and drying of concrete.

3.4 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01500.

B. Do not permit traffic over unprotected floor surface.

END OF SECTION

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SECTION 04065

MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes mortar and grout for masonry.

B. General Requirements: Perform the work of this section in accordance with Division One of these specifications.

1.2 REFERENCES

A. American Society for Testing and Materials:
1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
2. ASTM C91 - Standard Specification for Masonry Cement.
3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
8. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
9. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
10. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
11. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
12. ASTM C476 - Standard Specification for Grout for Masonry.
13. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
14. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
15. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.

1.3 SUBMITTALS

A. Samples: Submit two samples of mortar, illustrating mortar color and color range.

B. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

C. Test Reports:
1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content and compressive strength.
2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476 and test and evaluation reports to ASTM C1019.

D. Manufacturer's Installation Instructions: Submit premix mortar manufacturer's installation instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS MSJC Code and TMS MSJC Specification.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Hot and Cold Weather Requirements: TMS MSJC Specification.

PART 2 PRODUCTS

2.1 MORTAR AND MASONRY GROUT

A. Manufacturers:
1. Western Lime & Cement: Western Masons Mix Type S, or equal.

2.2 COMPONENTS

A. Portland Cement: ASTM C150, Type I, gray color.

B. Masonry Cement: ASTM C91, Type S.

C. Premix Mortar: ASTM C387, Type S. gray color, normal strength.

D. Mortar Aggregate: ASTM C144, standard masonry type.

E. Grout Aggregate: ASTM C404, fine and coarse.

F. Water: Clean and potable.

G. Mortar Color:
1. Mortar for face brick: color as selected. Colored mortar to be premixed.
2. All other mortar: uncolored.

H. Plasticizer: Water reducing type which reduces porosity and absorption to increase bond strength.

I. Water Repellent: Granular type; “Rohepel” by BASF, “Dry Block” by W.R. GRACE or approved equal.

J. Bonding Agent: Epoxy type.

2.3 MIXES

A. Mortar Mixes:

1. Mortar For Structural Masonry: ASTM C270, Type S using Property specification or to achieve 1800 psi strength.
2. Mortar For Non-Structural Masonry: ASTM C270, Type S using Property specification or to achieve 1800 psi strength.
3. Pointing Mortar: ASTM C270, Type N using Property specification.

B. Mortar Mixing:
1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
2. Achieve uniformly damp sand immediately before mixing process.
3. Add mortar color and admixtures to achieve uniformity of mix and coloration.
4. Re-temper only within two hours of mixing.

C. Grout Mixes:
1. Grout for Pilasters, Bond Beams and Lintels 3,000 psi strength at 28 days; 7-8 inches slump; mixed in accordance with ASTM C476 Coarse grout.

D. Grout Mixing:
1. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.
2. Add admixtures in accordance with Manufacturer's instructions; mix uniformly.
3. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 EXECUTIONS

3.1 EXAMINATION

A. Request inspection of spaces to be grouted.

3.2 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug cleanout holes with masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

3.3 INSTALLATION

A. Install mortar and grout.

B. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

C. Do not displace reinforcement while placing grout.

D. Remove excess mortar from grout spaces.

END OF SECTION

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SECTION 04820

REINFORCED UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes brick, decorative concrete masonry units, concrete masonry units, reinforcement, anchorage, and accessories.

1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 530 - Building Code Requirements for Masonry Structures.
   2. ACI 530.1 - Specifications for Masonry Structures.

B. American Society for Testing and Materials:
   1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
   4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   5. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   7. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   8. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
   9. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
   10. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
   11. ASTM C55 - Standard Specification for Concrete Brick.
   12. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
   13. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
   14. ASTM C73 - Standard Specification for Calcium Silicate Face Brick (Sand-Lime Brick).
   15. ASTM C90 - Standard Specification for Load bearing Concrete Masonry Units.
   16. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.

17. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
18. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
19. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
20. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal requirements.

B. Product Data:
1. Submit data for decorative and concrete masonry units, fabricated wire reinforcement, wall ties, anchors and other accessories.
2. Indicate initial rate of absorption for clay and shale brick.

C. Samples: Submit four samples of face brick units and decorative masonry units to illustrate color, texture and extremes of color range.

D. Shop Drawings: Indicate bars sizes, spacing, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement, and accessories.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Maintain one copy of each document on site.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 Building Code Requirements for Masonry Structures and ACI 530.1 Specification for Masonry Structures.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 MOCKUP

A. Section 01400 - Quality Requirements: Mock-up requirements.

B. Construct masonry wall mockup, 8 feet long by 6 feet high, including masonry, mortar and accessories.

C. Locate where directed by Architect/Engineer.

D. Remove mockup when directed by Architect/Engineer.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01300 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Accept units on site. Inspect for damage.

C. Protect concrete masonry units from wetting while stored at the job site.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F and in accordance with the following:
   1. Temperature of masonry units shall not be less than 32 degrees F when laid in masonry. Remove visible ice on masonry units before unit is laid in masonry.
   2. Heat mortar sand and/or mixing water to produce mortar temperatures between 50 and 120 degrees F at time of mixing. Maintain mortar above freezing until used in masonry.
   3. When ambient temperatures are between 20 and 32 degrees F, use heat sources on both sides of masonry under construction and install wind breaks when wind velocity is in excess of 15 mph.
   4. When ambient temperatures are below 20 degrees F, provide enclosure for masonry under construction and use heat sources for maintain temperatures above 32 degrees F within enclosure.
   5. When mean daily temperatures are between 32 and 40 degrees F, protect completed masonry from rain or snow by covering with weather resistant membrane for 24 hours after construction.
   6. When mean daily temperatures are between 25 and 32 degrees F, protect completed masonry by completely covering it with insulating blankets or equal protection for 24 hours.
   7. Where mean daily temperatures are below 25 degrees F, maintain masonry temperatures above 32 degrees F for 24 hours after construction by enclosure with supplementary heat, electric blankets, infrared heat lamps or other acceptable methods.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph and in accordance with the following:
   1. Do not spread mortar beds more than 4 ft ahead of masonry.
   2. Set masonry units within 1 minute of spreading mortar.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate masonry work with veneer and installation of window, door, louver and other openings in wall surface.

1.11 EXTRA MATERIALS

A. Section 01700 - Execution Requirements: Spare parts and maintenance products.

B. Supply 50 of each size, color, and type of face brick units.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Face Brick: ASTM C216, Type FBS, Grade SW
   1. Brick Size and Shape: Nominal size of 4 x 4 x 12 inches. Manufacturer & Color to be chosen by owner

B. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight.

C. Solid Load-Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight.

D. Concrete Brick Units: ASTM C55; normal weight.

E. Decorative Concrete Masonry Units: ASTM C90; normal weight, Nominal size 4 x 12 x 12 inches. (See drawings for brick mfr. and colors.)

F. Concrete Masonry Unit Size and Shape: Nominal modular size of 8” x 8” x 16” inches or 12”x8”x16” inches. Furnish special units for 90 degree corners, bond beams, lintels coved base and bullnosed corners for vertical corners including door and window openings.

G. Fluid Applied Air, Vapor & Water Resistive Barrier: “Prosoco” R-Guard VB.

H. Foam in place CMU cell insulation as specified in section 07214

2.2 ACCESSORIES

A. Single Wythe Joint Reinforcement: ASTM A951; truss type; steel 0.188 inch diameter side rods with 0.188 inch diameter cross ties; hot dip galvanized. Provide special corner and wall intersection pieces.

B. Multiple Wythe Joint Reinforcement: ASTM A951/A951M; truss type; steel; without moisture drip; adjustable type; 0.188 diameter side rods with 0.148 inch diameter cross ties; hot dip galvanized.

C. Reinforcing Steel: as specified in Section 03200.

D. Strap Anchors: bent steel shape, 1 ¾" x "length indicated or required" inch size x 1/8 inch thick, hot dip galvanized to ASTM A153/A153M B2 finish.

E. Wall Ties: Formed steel wire, 3/16 inch thick, adjustable, hot dip galvanized to ASTM A153/A153M B2 finish.

F. Dovetail Anchors: Bent steel strap, 1 x "length indicated or required" inch size x 12 gage thick, galvanized to ASTM A153/A153M B2 finish.

G. Anchor Rods: Headed, galvanized; J-shaped or L-shaped; minimum ½ inch diameter; spaced at not more than 48 inches on center; complete with washers and heavy hex nuts; anchors must be welded or hooked to not less than 0.20 square inches of bond beam reinforcement; sized for minimum 6 inch embedment. If anchors are not welded or hooked to reinforcement, anchors shall be embedded 15 inches into masonry.
   1. Hot-Dipped Galvanizing: ASTM A153/A153M.

H. Mortar and Grout: As specified in Section 04065.

I. Stainless Steel: ASTM A666, Type 304, soft temper; 0.010 inch thick; smooth finish.

J. Lap Sealant: Butyl type as specified in Section 07900.

K. Preformed Control Joints: Rubber material. Furnish with corner and tee accessories, heat fused joints. Use DuraWall D/A 2001 by DuraWall; Greenstreak Model 571 by Greenstreak; or approved equal.

L. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding; 3 inch wide x by maximum lengths.

M. Building Paper: ASTM D226, No. 15 asphalt saturated felt.

N. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.

O. Cavity Ventilation and Drainage
   1. Basis-of-design Product: Subject to compliance with requirements, provide Mortar Net Solutions; TotalFlash unitized flashing and cavity drainage system or equal.
   2. Weep Vents:
      a. Preformed UV-resistant plastic mesh (designed to fill head joint with outside face held back to match mortar in adjacent joints) allowing free flow of moisture and air. Select from manufacturer's standard colors to match adjacent mortar.
      b. Products: "Mortar Net Weep Vents" by Mortar Net, "Cell Vent" by Dur-O-Wall or equal.
   3. Embedded Flashing:
      a. Minimum 30 mil flexible membrane.

b. Products: “Nervastral” by Nervastral, “Perm-A-Barrier” by W.R.Grace, or equal.

4. Cavity Net:
   a. Preformed plastic mesh (designed to catch mortar droppings without clogging) allowing free flow of moisture and air.
   b. Products: “Mortar Net” by Mortar Net, “Mortar Stop” by Polytite, or equal.

P. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials. As recommended by face brick Manufacturer.

Q. Precast Concrete Lintels: type and, size, as indicated on drawings, 5000 psi strength at 28 days.

R. Reinforced unit masonry blocks filled with concrete and reinforced with steel as detailed.

S. Steel Lintels: size as indicated on Drawings; as specified in Section 05500

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify items provided by other sections of work are properly sized and located.

D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other Sections.

B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

3.3 INSTALLATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

C. Coursing of Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

D. Coursing of Brick Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 4 inches (100 mm).
   3. Mortar Joints: Concave.

E. Coursing of Decorative Concrete Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

F. Placing And Bonding:
   1. Lay solid masonry units in full bed of mortar, with full head joints.
   2. Lay hollow masonry units with face shell bedding on head and bed joints.
   3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
   4. Remove excess mortar as Work progresses.
   5. Interlock intersections and external corners.
   6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
   7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
   8. Cut mortar joints flush where wall tile is scheduled, cement parging is required, resilient base is scheduled, or bitumen dampproofing is applied.
   9. Isolate masonry from vertical structural framing members with movement joint as indicated on Drawings.
   10. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.

G. Weeps and Vents: Furnish weeps and vents in outer wythe at 24 inches oc horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

H. Cavity Wall: Do not permit mortar to drop or accumulated into cavity air space or to plug weeps. Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor barrier adhesive.

I. Joint Reinforcement and Anchorage – Single Wythe Masonry:
   1. Install horizontal joint reinforcement 16 inches oc.
   2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
   3. Place joint reinforcement continuous in first and second joint below top of walls.
   4. Lap joint reinforcement ends minimum 6 inches.
   5. Support and secure reinforcing bars from displacement.
   6. Embed anchors embedded in concrete and attached to structural steel members. Embed anchorages in every second block joint.
   7. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches oc.

J. Joint Reinforcement And Anchorage - Masonry Veneer:
   1. Install horizontal joint reinforcement 16 inches oc.

2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
3. Place joint reinforcement continuous in first and second joint below top of walls.
4. Lap joint reinforcement ends minimum 6 inches.
5. Embed wall ties in masonry backing to bond veneer at maximum inches 16 inches oc vertically and 16 inches oc horizontally. Place wall ties at maximum 8 inches oc vertically within 8 inches of jamb of wall openings.
6. Secure wall ties to stud framed backing and embed into masonry veneer at maximum 16 inches oc vertically and 16 inches oc horizontally.
7. Place wall ties at maximum 8 inches oc vertically within 8 inches of jamb of wall openings.
8. Place wall ties at maximum 8 inches on center horizontally within 8 inches of head and sill of wall openings.
9. Reinforce stack bonded unit joint corners and intersections with strap anchors at 8 inches oc.

K. Joint Reinforcement And Anchorages – Multiple Wythe Cavity Wall Masonry:
1. Install horizontal joint reinforcement 16 inches oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
3. Place joint reinforcement continuous in first and second joint below top of walls.
4. Lap joint reinforcement ends minimum 6 inches.
5. Embed anchorages in every second block.
6. Reinforce stack bonded unit joint corners and intersections with strap anchors at 16 inches oc.

L. Masonry Flashings:
1. Extend flashings horizontally through outer wythe at foundation walls, above ledge or shelf angles and lintels, under parapet caps, at bottom of walls, and turn down on outside face to form drip.
2. Turn flashing up minimum 8 inches and bed into mortar joint of masonry, seal to concrete or seal to sheathing over framed backing.
3. Lap end joints minimum 6 inches and seal watertight.
4. Turn flashing, fold, and seal at corners, bends, and interruptions.

M. Lintels:
1. Install loose steel lintels over openings.
2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.
3. Openings Up To 36 inches wide: Place two, No. 5 reinforcing bars 1 inch from bottom web.
4. Do not splice reinforcing bars.
5. Support and secure reinforcing bars from displacement.
6. Place and consolidate grout fill without displacing reinforcing.
7. Allow masonry lintels to attain specified strength before removing temporary supports.
8. Maintain minimum 8 inch bearing on each side of opening.

N. Grouted Components:
1. Reinforce bond beam with steel bars, 1 inch from bottom web see plans.

2. Lap splices as required by code.
3. Support and secure reinforcing bars from displacement.
4. Place and consolidate grout fill without displacing reinforcing.
5. At bearing locations, fill masonry cores with grout for minimum 16 inches either side of opening.

O. Reinforced Masonry:
1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.
3. Splice reinforcement in accordance with Section 03200.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.

P. Control and Expansion Joints:
1. Do not continue horizontal joint reinforcement through control and expansion joints.
2. Form control joint with sheet building paper bond breaker fitted to one side of hollow contour end of block unit. Fill resultant elliptical core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant or install preformed control joint device in continuous lengths. Seal butt and corner joints.
3. Do not use preformed control joint devices at control joints above or below openings.
4. Size control joint in accordance with Section 07900 for sealant performance.
5. Form expansion joint by omitting mortar and cutting unit to form open space. Placed as indicated on Drawings.

Q. Built-In Work:
1. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
2. Install built-in items plumb and level.
3. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
4. Do not build in materials subject to deterioration.

R. Cutting and Fitting:
1. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
2. Obtain Architect/Engineer’s approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements, 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Brick Units: Test each type in accordance with ASTM C67, 5 random units for each 50,000 units installed.

C. Concrete Masonry Units: Test each type in accordance with ASTM C140.

3.6 CLEANING

A. Section 01700 - Execution Requirements: Final cleaning.

B. Remove excess mortar and mortar smears as work progresses.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.7 PROTECTION OF WORK

A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.

B. Protect exposed external corners subject to damage.

C. Protect base of walls from mud and mortar splatter.

D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.

E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Structural shapes.
2. Channels and angles.
3. Hollow structural sections.
4. Structural pipe.
5. Structural plates and bars.
6. Fasteners, connectors, and anchors.
7. Grout.

1.2 REFERENCES

A. American Institute of Steel Construction:
1. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.

B. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
7. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
8. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
9. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
10. ASTM A449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs.
11. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
12. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
13. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.

14. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
15. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
16. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
17. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4-in. (100-mm) Thick.
18. ASTM A618/A618M - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
19. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
20. ASTM A847/A847M - Standard Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.
21. ASTM A852/A852M - Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick.
22. ASTM A913/A913M - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST).
23. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
24. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
25. ASTM E94 - Standard Guide for Radiographic Examination.
26. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.
27. ASTM E165 - Standard Test Method for Liquid Penetrant Examination.
28. ASTM E709 - Standard Guide for Magnetic Particle Examination.
29. ASTM F436 - Standard Specification for Hardened Steel Washers.
30. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
31. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
32. ASTM F1852 - Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

C. American Welding Society:
   1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   2. AWS D1.1 - Structural Welding Code - Steel.

D. Research Council on Structural Connections:
   1. RCSC - Specification for Structural Joints Using ASTM A325 Bolts.

E. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC Paint 15 - Steel Joist Shop Paint.

3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
4. SSPC SP 3 - Power Tool Cleaning.
5. SSPC SP 6 - Commercial Blast Cleaning.
6. SSPC SP 10 - Near-White Blast Cleaning.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:
1. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
2. Connections including those not detailed.
3. Cambers
4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Mill Certificate: Certify products meet or exceed specified requirements.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the State Standards in which the Project is located.

B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Fabricator: Company specializing in performing Work of this section with minimum 3 years documented experience.

B. Erector: Company specializing in performing Work of this section with minimum 3 years documented experience.

C. Shop Painter: Company specializing in performing Work of this section with minimum 3 years documented experience.

D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

1.6 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural W-Shapes: ASTM A992/A992M; Grade 50

B. Structural M-Shapes: ASTM A36/A36M

C. Structural S-Shapes: ASTM A529/A529M; Grade 50

D. Structural T-Shapes: Cut from structural W-shapes, M-shapes, or S-shapes.

E. Channels and Angles: ASTM A36/A36M

F. Square and Rectangular Hollow Structural Sections: ASTM A500/A500M, Grade B

G. Structural Pipe: ASTM A53/A53M, Grade B, Schedule 40

H. Structural Plates and Bars: ASTM A36/A36M. Unless otherwise noted on Drawings

2.2 FASTENERS, CONNECTORS, AND ANCHORS

A. High Strength Bolts: ASTM A325; Type 1 unless otherwise noted on the Drawings
   1. Finish: Hot dipped galvanized.

B. Nuts: ASTM A563 heavy hex type.
   1. Finish: To match bolt finish

C. Shear Connectors: ASTM A108; Grade 1010 headed, unfinished and in accordance with AWS D1.1; Type B.

D. Anchor Rods: Grade 36 unless otherwise indicated on Drawings
   1. Shape: Hooked
   2. Plate Washers: ASTM A36/A36M.

E. Threaded Rods: ASTM A36/A36M
   1. Finish: Hot dipped galvanized

F. Forged Structural Steel Hardware:
   1. Clevises and Turnbuckles: ASTM A108; Grade 1085.
   2. Eye Nuts and Eye Bolts: ASTM A108; Grade 1030.
   3. Sleeve Nuts: ASTM A108; Grade 1018.
   4. Rod Ends, Yoke Ends and Pins, Cotter Pins, and Coupling Nuts: Carbon steel.

2.3 WELDING MATERIALS

A. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 ACCESSORIES

A. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi at 28 days.

B. Shop Primer: SSPC Paint 15, Type 1, red oxide.

C. Touch-Up Primer: Match shop primer.

2.5 FABRICATION

A. Space shear stud connectors as indicated on Drawings.

B. Fabricate connections for bolt, nut, and washer connectors.
   1. Beam Connections" AISC standard 2-angle web connections or single plate framing connection capable of supporting a minimum of 50% of the total uniform load capacity of members joined as tabulated in uniform load tables of AISC "Manual of Steel Construction", or as shown.
   2. Connections shall consist of a minimum of two ¾" diameter bolts or welds developing minimum of 10,000 pounds.
   3. Make bearing type field connections with minimum ¾" diameter A325 bolts with threads included in the shear plane unless otherwise detailed.
   4. Weld shop connections except as noted otherwise on Drawings.

C. Develop required camber for members.

2.6 FINISH

A. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

B. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication only where indicated on the Drawings.

C. Galvanizing for Fasteners, Connectors, and Anchors:
   1. Hot-Dipped Galvanizing: ASTM A153/A153M.

2.7 SOURCE QUALITY CONTROL AND TESTS

A. Section 01400 - Quality Requirements: Testing, inspection and analysis requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify bearing surfaces are at correct elevation.

C. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

3.2 PREPARATION

A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

3.3 ERECTION

A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.

B. Field weld components and shear connectors indicated on Drawings

C. Field connect members with threaded fasteners; torque to required resistance tighten to snug tight for bearing type connections.

D. Do not field cut or alter structural members without approval of Architect/Engineer.

E. After erection, touch up welds and abrasions to match shop finishes.

3.4 GROUT INSTALLATION

A. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.

B. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.

C. Moist cure grout.

D. Remove forms after grout is set. Trim grout edges to from smooth surface, splayed 45 degrees.

E. Tighten anchor bolts after grout has cured for a minimum of 3 days.

3.5 ERECTION TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: ¼ inch per story, non-cumulative.

C. Maximum Offset From Alignment: ¼ inch

3.6 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements, 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Bolted Connections: Inspect in accordance with AISC 303.
   1. Visually inspect all bolted connections.

C. Welding: Inspect welds in accordance with AWS D1.1.
   1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   2. Visually inspect all welds.

D. Correct defective bolted connections and welds.

END OF SECTION

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SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes shop fabricated metal items.

1.2 REFERENCES

A. Aluminum Association:
   1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Society of Mechanical Engineers (ASME):
   1. ASME Boiler and Pressure Vessel Code Section IX

C. American Society for Testing and Materials:
   1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
   2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
   6. ASTM A283/283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   7. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
   8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   9. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   10. ASTM A992/A992M - Standard Specification for Structural Steel Shapes
   11. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   12. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
   13. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
   14. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   15. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
   16. ASTM F436 - Standard Specification for Hardened Steel Washers.
   17. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

D. American Welding Society:
   1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   2. AWS D1.1 - Structural Welding Code - Steel.
   3. AWS D1.6 - Structural Welding Code - Stainless Steel.

E. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC SP 1 - Solvent Cleaning.
   3. SSPC SP 10 - Near-White Blast Cleaning.
   4. SSPC Paint 15 - Steel Joist Shop Paint.
   5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, finishes, size and type of fasteners, and accessories. Provide pressure calculations of access hatches. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

C. Manufacturer's Installation Instructions: Indicate installation requirements, and rough-in dimensions.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 QUALIFICATIONS

A. Design under direct supervision of Professional Engineer experienced in design of this Work and licensed in State in which the Work is located.

B. If requested by Engineer or required on Drawings, submit calculations sealed by a Professional Engineer licensed in the State in which the Work is located.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Accept metal fabrications on site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather.

1.6 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Structural W-Shapes: ASTM A992/A992M.

B. Channels and Angles: ASTM A36/A36M

C. Hollow Structural Sections: ASTM A500/A500M, Grade B

D. Plates: ASTM A283/A283M.

E. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40.

F. Sheet Steel: ASTM A653/A653M, Grade 33 Structural Quality, galvanized.

G. Bolts ASTM A325; Type 1.
   1. Finish Hot dipped galvanized to ASTM A153/A153M

H. Nuts: ASTM A563 heavy hex type.
   1. Finish Hot dipped galvanized to ASTM A153/A153M

I. Washers: ASTM F436; Type 1.
   1. Finish Hot dipped galvanized to ASTM A153/A153M

J. Welding Materials: AWS D1.1; type required for materials being welded.

K. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

L. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic.

2.2 MATERIALS – STAINLESS STEEL

A. Exterior and submerged uses: Type 316

B. Industrial uses: Type 316

C. Interior and architectural uses: Type 304 unless otherwise noted

D. Cast-in-place anchor bolts: Type 316, unless otherwise noted

E. Welding Materials: AWS D1.1; type required for materials being welded.

2.3 MATERIALS - ALUMINUM

A. Structural Shapes and Plates: Alloy 6061, Temper T6. As required by ASTM sections referenced in the Aluminum Association’s current Construction Manual.

B. Bolts, Nuts, and Washers: Type 316 Stainless steel.

C. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 ANCHOR BOLTS

A. Anchor Bolts for Equipment and Machinery, where permanently anchored into concrete: Stainless steel, unless otherwise shown. The diameter, length, and any bend dimensions shall be as required by the equipment or machinery manufacturer. Unless otherwise required, use 3/4-inch minimum diameter and other geometry shown on the Drawings. Furnish a minimum of two nuts and a washer of the same material for each bolt. Provide sleeves as required or as shown for location adjustment.

B. Anchor Bolts for Other Uses to anchor fabricated metalwork or structural building columns, or other components where the connection will be protected or dry: Galvanized ASTM A307; Grade A, steel. Minimum size shall be 3/4-inch diameter by 12-inch long, unless otherwise shown. Furnish two nuts and one washer per bolt of the same material as the bolt, unless otherwise shown.

C. Anchor Bolts for Other Uses to anchor fabricated metalwork or structural building, or structural frame components in areas of wet use, wash down areas, or areas outside heated buildings: Stainless steel. Minimum size shall be 3/4-inch diameter by 12-inch long, unless otherwise shown. Furnish two nuts and one washer per bolt of the same material as the bolt, unless otherwise shown.

D. Where stainless steel nuts and machined bolts, anchor bolts, concrete anchors, and all other threaded fasteners are used, Contractor shall apply an anti-seizing lubricant to the threads before making up the connections. The lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc or copper.

2.5 CONCRETE ANCHORS

A. Expansion Anchors:
   1. Product/Manufacturers
      a. Kwik Bolt 3 Expansion Anchor by Hilti
      b. Kwik Bolt TZ Expansion Anchor by Hilti
      c. HSL-3 Heavy Duty Expansion Anchor by Hilti
      d. Power-Bolt by Powers Fasteners
      e. Power-Stud by Powers Fasteners
      f. Or approved equal
   2. Usage: In concrete – dry - above 1’-6” the peak (maximum) water surface in any water/liquid containing structure.
      a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
      b. Zinc or chromate-plated carbon steel may be used in interior locations with controlled humidity, and other protected locations unless otherwise noted.
      c. Do not use expansion anchors when submerged, subject to dynamic loads or in overhead applications.

B. Adhesive Anchors:
   1. Product/Manufacturers

a. HIT-RE 500-SD by Hilti
b. HIT HY 150 MAX by Hilti
c. HIT ICE/HIT HY 150 Adhesive by Hilti
d. AC100+Gold by Powers Fasteners
e. PE+ by Powers Fasteners
f. Or approved equal

2. Usage: In concrete – submerged – below 1'-6" the peak (maximum) water surface in any water/liquid containing structure.
a. Stainless steel, Type 316,
b. Do not use when subject to dynamic loads and overhead applications.

C. Undercut Anchors:
1. Product/Manufacturers
a. Maxi-Bolt undercut anchor system by Drillco Devices, Ltd.
b. HDA Undercut Anchor by Hilti
c. Or approved equal
2. Usage: In concrete – overhead applications, and for dynamic loads
a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
b. Zinc or chromate-plated carbon steel may be used where totally embedded, in interior locations with controlled humidity, and other protected locations unless otherwise noted.
c. Do not use undercut anchors when submerged.

D. Screw Anchors:
1. Product/Manufacturers
a. HUS-H Concrete Screw Anchot by Hilti
b. Kwik Con II Screw Anchor by Hilti (for non-structural applications)
c. Wedge-Bolt by Powers Fasteners
d. Tapper by Powers Fasteners (for non-structural applications)
e. Or approved equal
2. Usage: In concrete – dry - above 1'-6" the peak (maximum) water surface in any water/liquid containing structure.
a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
b. Zinc or chromate-plated carbon steel may be used in interior locations with controlled humidity, and other protected locations unless otherwise noted.
c. Do not use screw anchors when submerged, subject to dynamic loads or in overhead applications.

E. Tie-Wire Anchors: Type 316 stainless steel, Powers SPIKE or approved equal.

2.6 MASONRY ANCHORS

A. Hollow Core Concrete Block
1. Product/Manufacturers
a. HIT HY 20 Adhesive by Hilti
b. HIT HY 150 MAX by Hilti
c. AC100+Gold by Powers Fasteners

d. PE+ by Powers Fasteners
e. Or approved equal

2. Usage: In hollow core concrete block
   a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
   b. Zinc or chromate-plated carbon steel may be used where totally embedded, in interior locations with controlled humidity, and other protected locations unless otherwise noted.
   c. Install per manufacturers recommendation.

B. Grout Filled Concrete Block

1. Product/Manufacturers
   a. AC100+Gold by Powers Fasteners
   b. PE+ by Powers Fasteners
   c. HIT HY 150 MAX by Hilti
   d. HIT ICE/HIT HY 150 Adhesive by Hilti
   e. Kwik Con II Screw Anchor by Hilti (for non-structural applications)
   f. Tapper by Powers Fasteners (for non-structural applications)
   g. Or approved equal
2. Usage: In grout filled concrete block
   a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
   b. Zinc or chromate-plated carbon steel may be used where totally embedded, in interior locations with controlled humidity, and other protected locations unless otherwise noted.
   c. Install per manufacturers recommendation.

2.7 COMPONENTS

A. Following is list of principal items only. Refer to Drawings for items not specifically scheduled.

1. Structural Steel: As specified in Section 05120.
2. Steel Joist Framing: As specified in Section 05210
3. Steel Floor Deck: As specified in Section 05311
4. Steel Roof Deck: As specified in Section 05312
5. Cold-Formed Metal Framing: As specified in Section 05400
6. Metal Stairs and Ladders: As specified in Section 05510.
7. Handrails and Railings: As specified in Section 05520.
8. Lintels: As detailed on Drawings; prime paint finish.
9. Grating and Floor Plate: As specified in Section 05530.

2.8 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.9 FACTORY APPLIED FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime paint items in accordance with Section 09900.

D. Galvanized Structural Steel Members: Galvanize after fabrication to ASTM A123. Furnish minimum 1.25 oz/sq ft galvanized coating.

E. Galvanized Non-structural Items: Galvanized after fabrication to ASTM A123. Furnish minimum 1.25 oz/sq ft galvanized coating.

2.10 FACTORY APPLIED FINISHES - ALUMINUM

A. Exposed Aluminum Surfaces: Mill finish.

B. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.11 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.

B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.

C. Field weld components indicated on Drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain approval of Engineer prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

G. Install in accordance with Drawings, shop drawings and manufacturer's instructions.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story or for every 12 ft in height whichever is greater, non-cumulative.

B. Maximum Offset from Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rough carpentry, roof sheathing, blocking in walls and roof openings, curbs, miscellaneous framing and sheathing, and wood treatment.

1.2 REFERENCES

A. MIL-L-1914-C Lumber and Plywood, Fire Retardant Treated.

B. MIL-V-13518C(1) Wood Preservative: Tetrachlorophenol and Pentachlorophenol, Surface Sealing Compound.

C. PS 1 - Construction and Industrial Plywood.

D. PS 20 - American Softwood Lumber Standard.

E. PS 51 - Hardwood and Decorative Plywood.

F. PS 58 - Basic Hardwood.

G. NFPA - National Design Specification for Wood Construction.

H. APA - American Plywood Association.

I. AWPA - American Wood Preservers' Association. U1 - Use Category System: User Specification for Treated Wood.

J. UL – Fire Resistance Directory.

K. ASTM D635 – Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

L. ASTM E84 – Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

A. Rough Carpentry Lumber: Visible grade stamp, of agency certified by National Forest Products Association (NFPA).

B. Plywood Grading Agency: Certified by APA.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 01330.

B. Submit product data under provisions of Section 01330.

C. Provide technical data on wood preservative materials and application instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver shop fabricated carpentry items until site conditions are adequate to receive the work. Protect items from weather while in transit.

B. Store indoors, in ventilated areas with a constant, minimum temperature of 60 degrees F (16 degrees C), maximum relative humidity of 25 to 55 percent.

PART 2 PRODUCTS

2.1 ROUGH CARPENTRY MATERIALS

A. Lumber: PS 20; graded in accordance with established Grading rules; maximum moisture content of 19 percent; of following species and grades:
   1. Structural Light Framing: Stress Group A; select structural; No. 1 grade.
   2. Non-structural Light Framing: Stress Group A; construction, grade.
   3. Studding: Stress Group A; stud grade.
   4. Structural Joists and Planks: Stress Group A; No. 1 grade.

B. Douglas Fir Plywood: Sheathing, APA rated, Exposure 1 grade.

C. Structural Sheathing: APA rated plywood sheathing, Structural 1 category, PS 1, Exterior Exposure bond classification. Span rating as indicated on drawings.

D. Poplar Plywood: Solid sheathing grade; exterior waterproof type.

E. Wood Particleboard: Composed of wood chips type made with high waterproof resin binders of grade to suit application; sanded faces.

F. Pressure Treated Southern Pine:
   1. Select structural or No. 1SR grade.
   2. Wood Preservative (Pressure Treatment): micronized copper quat (MCQ), 0.40 lbs. per cu.ft.
   3. AWPA Standards U1
   4. Treat all cut ends.

G. Nails, Spikes and Staples: Galvanized for exterior locations, high humidity locations and treated wood; plain finish for other interior locations; size and type to suit application.

H. 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.

I. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolts or power activated type for anchorage to steel.

J. Screws: Bugle head, steel, power driven type length of three times thickness of sheathing. Screw shall be corrosion-resistant. Use Type S-12 screws when attaching to heavy steel gauge (12 to 22 gauge) and Type S screw for light gauge framing. Use Type W screws for wood framing.

K. Weather Barrier: spunbonded polyolefin, non-woven, non-perforated.

2.2 WOOD TREATMENT

A. Fire Retardant: Chemically treated and pressure impregnated.
   1. AWPB LP-3, aboveground application, light petroleum solvent.
   2. AWPB LP-33 ground contact application, light petroleum solvent.

B. Provide preservative treated wood for all framing, blocking, furring, nailing strips built into exterior masonry walls, wood in contact with concrete and in conjunction with gravel stops, and roofing.

C. Redry and clean lumber, after treatment, to maximum moisture content of 19 percent, stamped DRY.

D. Apply two brush coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber.

PART 3 EXECUTION

3.1 FRAMING, FURRING, AND STRIPPING

A. Erect wood framing, furring, stripping and nailing members true to lines and levels. Do not deviate from true alignment more than 1/4 inch.

B. Place horizontal members laid flat, crown side-up.

C. Construct members of continuous pieces of longest possible lengths.

D. Space members at 16 o.c. unless indicated otherwise.

E. Double members at openings over one square foot. Space short studs over and under opening to stud spacing.

F. Construct double joist headers at floor and ceiling openings. Frame rigidly into joists.

G. Bridge joists in excess of eight feet span at mid-span members. Fit solid blocking at end of members.

H. Lay out, cut, fit, and install all rough carpentry items. Anchor sufficiently to ensure rigidity and permanence.

I. Install items accurate to dimension, true to line, level, and square. Provide for installation and support of other work.

J. Verify that surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

K. Install all wood in conjunction with roofing using screw attachment to metal decking and steel framing. Bolt wood blocking to masonry where indicated

L. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations

END OF SECTION

SECTION 06173

WOOD TRUSSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes shop fabricated wood trusses for roof framing; bridging, bracing, and anchorage; and preservative treatment of wood.

1.2 REFERENCES

A. ALSC (American Lumber Standards Committee) - Softwood Lumber Standards.

B. ANSI A208.1 - Mat-Formed Wood Particleboard.

C. APA (APA/Engineered Wood Association) - Plywood Grading Rules.

D. APA/EWA TB-200 (APA/Engineered Wood Association) - Technical Bulletin (Fire Retardant).

E. ASTM A167 - Stainless and Heat Resisting Chromium - Nickel Steel Plate, Sheet, and Strip.

F. ASTM A653/A653M - Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

G. AWPA C1 (American Wood Preservers Association) - All Timber Products Preservative Treatment by Pressure Process.

H. AWPA C20 (American Wood Preservers Association) -Structural Lumber Fire Retardant Treatment by Pressure Process.

I. NFPA (National Forest Products Association) - Lumber Grading Rules.

J. SPIB (Southern Pine Inspection Bureau) - Lumber Grading Rules.

K. TPI DSB-89 (Truss Plate Institute) - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses.

L. TPI HIB-91 (Truss Plate Institute) - Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses.

M. ANSI/TPI 1 - (Truss Plate Institute) National Design Standard for Metal Plate Connected Parallel Chord Wood Trusses.

N. WCLIB (West Coast Lumber Inspection Bureau) - Lumber Grading Rules.

O. WWPA (Western Wood Products Association) - Lumber Grading Rules.

1.3 SYSTEM DESCRIPTION

A. Design Roof Live Load: 30 lbs/sq ft with deflection limited to 1/240 of span including dead loads, ceiling load, and snow drift load.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate sizes and spacing of trusses and associated components, web and chord sizes, plate sizes, fastener descriptions and spacings, loads and truss cambers, framed openings. Submit design calculations, sealed and signed by engineer.

C. Product Data: Submit truss configurations, bearing and anchor details, bridging and bracing.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:
   1. Lumber Grading Agency: Certified by ALSC.
   2. Plywood Grading Agency: Certified by APA/EWA.

B. Truss Design, Fabrication, and Installation: In accordance with ANSI/TPI 1 and TPI HIB-91.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Design trusses under direct supervision of a professional engineer experienced in design of this Work and licensed in the state where the Project is located.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Handle and erect trusses in accordance with TPI HIB-91.

C. Store truss depth in vertical position resting on intermittent bearing pads.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Alpine Engineered Products, Inc.

2. Standard Structures, Inc.
3. Warren Truss Co.
4. Substitutions: Section 01600 - Product Requirements.

2.2 MATERIALS

A. Lumber Grading Rules: NFPA. SPIB. WCLIB. WWPA.

B. Steel Plate Connectors: ANSI/TPI 1, Section 6; hot dip galvanized; die stamped with integral teeth.

C. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.3 ACCESSORIES

A. Wood Blocking, Support Members, Framing for Openings: In accordance with Section 06100 softwood lumber, construction grade, 19 percent maximum and 7 percent minimum moisture content.

B. Fasteners and Anchors:
1. Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
2. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

C. Bearing Plates: Hot dip galvanized.

2.4 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Brace wood trusses for support in accordance with TPI HIB-91.

C. Provide top chord extensions as indicated.

D. Fabricate to achieve minimum end bearing of:
1. 1-1/2 inches on wood or steel.
2. 3 inches on masonry.

E. Frame special sized openings in web framing as detailed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

A. Coordinate placement of support items.

3.3 ERECTION

A. Set members level and plumb, in correct position.

B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Do not field cut or alter structural members without approval of Architect/Engineer.

D. Place headers and supports to frame openings.

E. Frame openings between trusses with lumber in accordance with Section 06100.

F. Coordinate placement of sheathing with work of this Section.

G. After erection, touch-up damaged surfaces with primer consistent with shop coat.

3.4 SITE APPLIED WOOD TREATMENT

A. Brush apply one coats of preservative treatment on wood in contact with cementitious materials roofing and related metal flashings. Treat site-sawn cuts.

B. Allow preservative to dry prior to erecting members.

3.5 ERECTION TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION

SECTION 07212

BOARD INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation at cavity wall construction, perimeter foundation wall and underside of floor slab.

1.2 REFERENCES

A. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

B. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.

C. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.

1.3 PERFORMANCE REQUIREMENTS

A. Materials of this Section shall provide continuity of vapor and air barrier at building enclosure elements in conjunction with vapor barrier materials in Section 03300.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide data on product characteristics, performance criteria, and limitations.

C. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation, installation techniques.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.6 COORDINATION

A. Coordinate the Work with Section 03300 for installation of vapor barrier below concrete slabs.

PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

A. Dow Chemical Company, "Styrofoam".

B. Owens Corning, "Foamular".

C. Approved Equal.

2.2 INSULATION MATERIALS

A. Polystyrene Insulation: ASTM C578 Type IV; extruded cellular type, conforming to the following:

Thermal Resistance	R of 5.0 per inch Thickness when at 75 degrees F mean temperature
Thickness	Shall be 2 inches unless otherwise indicated
Board Size	16 x 96 inches at masonry cavity walls 24 x 96 inches at other areas
Compressive Strength	Minimum 25 psi
Water Absorption	In accordance with ASTM D2842, 0.3 percent by volume maximum
Edges	Square edges

2.3 ADHESIVES

A. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 ECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation.

B. Verify substrate surface is flat, free of honeycomb fins and irregularities and materials or substances that may impede adhesive bond.

3.2 INSTALLATION - FOUNDATION PERIMETER

A. Adhere boards to all foundation wall perimeters, horizontally. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.

B. Insulation boards shall cover foundation wall from first floor flashing (or stepped wall flashing at exposed concrete foundation wall) to top of foundation footing or down 10'-0" below grade line if lower floor level is present.

C. Lap insulation boards unbonded over foundation control joints 6 inches.

3.3 INSTALLATION - UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Prevent insulation from being displaced or damaged while placing vapor barrier and placing slab.

3.4 PROTECTION OF FINISHED WORK

A. Do not permit Work to be damaged prior to covering insulation.

END OF SECTION

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SECTION 07213

BATT AND BLANKET INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Batt insulation and vapor barrier in exterior wall and ceiling and roof construction.
2. Batt insulation for filling perimeter window, door shim spaces and crevices in exterior wall and roof.

B. General Requirements: Perform work of this Section in accordance with Division One of these specifications.

1.2 REFERENCES

A. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

B. FS HH-I-521 - Insulation Blankets, Thermal, (Mineral Fiber for Ambient Temperatures).

C. FS HH-I-558 - Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type).

1.3 PERFORMANCE REQUIREMENTS

A. Materials of this Section shall provide continuity of thermal barrier at building enclosure elements.

B. Materials of this Section shall provide continuity of vapor and air barrier at building enclosure elements.

1.4 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and limitations.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS - INSLATION MATERIALS

A. Johns Manville

B. Certain Teed

C. Owens-Corning Corp.

D. Substitutions: Under provisions of Section 01600.

2.2 MATERIALS

A. Batt Insulation: ASTM C665, Type I without membrane; preformed glass fiber batt, friction fit. Thermal resistance value as shown on drawings.

B. Vapor Barrier: Polyethylene film for above grade application, 6 mil thick.

C. Tape: Polyethylene self-adhering type, 2 inches wide.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

A. Install insulation in accordance with insulation manufacturer's instructions.

B. Install in exterior walls without gaps or voids.

C. Trim insulation neatly to fit spaces.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.

E. Install with factory applied membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.

F. Staple or nail in place at maximum 6 inches oc.

G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

H. At Metal Framing: Where indicated, place vapor barrier on warm side of insulation; lap and seal sheet barrier joints over member face. Tape all laps and penetrations.

I. Extend vapor barrier tight to full perimeter of adjacent window and door frames and other items interrupting the plane of membrane. Tape and seal in place.

END OF SECTION

SECTION 07214

FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes foamed-in-place insulation as core fill for concrete masonry units.

B. Related Sections: Section 04820: Reinforced Unit Masonry Assemblies.

1.2 REFERENCES

A. ASTM C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus.

B. ASTM D1621 - Test Method for Compressive Properties of Rigid Cellular Plastics.

C. ASTM D1622 - Test Method for Apparent Density of Rigid Cellular Plastics.

D. ASTM D2482 - Test Method for Surface Strength of Paper Wax Pick Test.

E. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

F. ASTM E96 - Test Method for Water Vapor Transmission of Materials.

1.3 PERFORMANCE REQUIREMENTS

A. Meet or better: a flame spread index of 0-5 and a smoke-developed value of 100-185, in accordance with ASTM E84.

B. Meet or better: a thermal conductivity of 0.224 Btu-in/hr./sq.ft and a linear shrinkage of 1.86 percent in length and 1.98 percent in width, in accordance with ASTM C177.

C. Meet or better: a moisture absorption of 1.90 percent on a volume basis in accordance with ASTM-D-1622.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, insulation properties, preparation requirements, and manufacturer’s installation instructions.

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 and approved by manufacturer.

PART 2 PRODUCTS

2.1 FOAMED-IN-PLACE INSULATION

A. Products and Manufacturers:
   1. Core-Fill 500; Tailored Chemical Products, Hickory, NC
   2. Thermco Foam; Thermal Corporation of America, Mt. Pleasant IA
   3. Or approved equal.

2.2 SYSTEM

A. Cold setting, two component liquid process, forming a low density resilient foam.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division One - Administrative Requirements: Coordination and project conditions.
   1. Maximum lift of 14 feet.
   2. Allow 2 weeks after installation prior to painting walls.

B. Verify Work within construction spaces or crevices is complete prior to insulation application.

C. Verify surfaces are clean, dry, and free of matter capable of inhibiting proper installation and curing.

3.2 INSTALLATION

A. Apply insulation to uniform monolithic density without voids in a manner to assure complete cavity fill.

B. Apply with liquid ratio at the mixing gun strictly within manufacturer’s specified range. A cubic foot shall weigh between 2.5 lbs and 3.4 lbs.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

A. Division One - Execution Requirements: Protecting installed construction.

B. Protect completed work from excessive moisture.

END OF SECTION

SECTION 07410

PREFORMED METAL STANDING SEAM ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section covers the pre-finished, pre-fabricated Architectural standing seam roof system. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings as part of this section.

B. Drawings and general provisions of the Contract, including general and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 SUMMARY

A. Section Includes
   1. Factory formed Standing Seam metal roof panels
   2. Snow Retention System

B. Related work specified elsewhere. (Note: select from the below or add appropriate sections)
   1. Section 05120 - Structural Steel
   2. Section 05500 - Metal Fabrications
   3. Section 06173 - Wood Trusses
   4. Section 07620 - Flashing and Sheet Metal Flashing and Trim

1.3 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal, and accessories necessary for a complete weathertight roofing system.

B. References:
   1. American Society for Testing and Materials (ASTM)
      a. ASTM A 653: Steel Sheet, Zinc Coated by the Hot Dip Process
      b. ASTM A 792: Stee
      c. l Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process
      d. ASTM B 209: Aluminum and Aluminum Alloy Sheet and Plate
      e. ASTM B370 Standard Specification for Copper Sheet and Strip for Building Construction
   2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
      a. SMACNA Architectural Sheet Metal Manual, 1993 edition
   3. American Iron and Steel Institute (AISI)
      a. AISI Cold Formed Steel Design Manual
   4. Aluminum Association
      a. Aluminum Design Manual
   5. Metal Construction Association
      a. Preformed metal Wall Guidelines

6. Code References
    a. ASCE, Minimum Loads for Buildings and Other Structures
    b. IBC National Building Codes

1.4 QUALITY ASSURANCE

A. Petersen Aluminum Corp, Andover, MN 877-571-2025 products establish a minimum of quality required.

B. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.

C. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.

1.5 SUBSTITUTIONS

A. The material, products and equipment specified in this section establish a standard for required function, dimension, appearance and quality to be met by any proposed substitution.

1.6 SYSTEM DESCRIPTION

A. Material to comply with:
    1. ASTM A792/A792M Standard Specification for Sheet Steel, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip process.

1.7 ROOF SYSTEM PERFORMANCE TESTING

A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation or other defects in construction.

B. Roof System shall be designed to meet Standard Building Code Wind Load requirements.

C. Panels to meet:
    1. Water Penetration: When tested per ASTM E-283/1680 and ASTM E-331/1646 there shall be no uncontrolled water penetration or air infiltration through the panel joints.
    2. Roof System shall be designed to meet a UL Class 90 wind uplift in accordance with UL standard 580 and panel system shall be ASTM 1592 Tested and approved
    3. UL 2218 - Impact Resistance rated.

1.8 WARRANTIES

A. Weathertight warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
    1. Warranty Period: 20 Years from date of Substantial Completion

B. Wind and Ventilation Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace ventilation system for 20 years or the lifetime of the roof on which it was originally installed, whichever comes first.

C. Finish warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace standing seam metal roof panels that show evidence of deterioration of factory-applied finish within specified warranty period.
   1. Exposed Panels Finish - deterioration includes the following:
      a. Color fading more than 5 hunter units when tested according to ASTM D 2244
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214
      c. Cracking, checking, peeling or failure of a paint to adhere to a bare metal.
   2. Warranty Period: 20 Years from the date of substantial completion

D. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight condition.

1.9 SUBMITTALS

A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation.

B. Provide finish samples of all colors specified.

C. Shop drawings: Show fabrication and installation layouts of metal roof panels, metal wall panels or metal soffit panels, details of edge conditions, side-seam joints, panel profiles, corners, anchorages, trim, flashings, closures and accessories, and special details. Distinguish between factory and field-assembled work.

D. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installer of the items involved:
   1. Roof panels and attachments
   2. Wood trusses, bracings and supports
   3. Roof-mounted items including snow guards and items mounted on roof curbs.

E. Snow Retention system Submittals
   1. Shop Drawings: Include roof plans showing locations of snow guards on roof and attachment details and spacing.
   2. Product Data: Product Description, construction details, material descriptions, individual component dimensions, finishes, and installation instructions.
   3. Samples: Clamp samples
   4. Include calculation of number and location of snow guards based on designed roof snow load, roof slope, roof type, components, spacings and finish.
   5. Test results: Results of product tensile load testing, issued by a recognized independent testing laboratory, showing ultimate load-to-failure value of attachment.

1.10 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instruction and lead time requirements to avoid construction delays.

B. Deliver components, sheets, metal roof panels and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

C. Unload, store and erect metal roof panels in a manner to prevent bending, warping, twisting and surface damage.

D. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting or other surface damage.

E. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.11 PROJECT CONDITIONS

A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed.

B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.12 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports and roof penetrations with actual equipment provided.

B. Coordinate metal roof panels with rain drainage work, flashing, trim and construction of decks, parapet walls and other adjoining work to provide a leakproof, secure and noncorrosive installation.

PART 2 - PRODUCTS

2.1 PANEL DESIGN

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates and accessories required for a weathertight installation.

B. Roof panels shall be Snap Clad standing seam in 16" widths with 1 3/4" high seam.

C. Panels to be produced with Factory supplied hot melt mastic in the seams.

D. Panels to be produced smooth.

E. Panels to be designed for attachment with concealed fastener clips, spaced as required by the manufacturer to provide for both positive and negative design loads, while allowing for the expansion and contraction of the entire roof system resulting from variations in temperature.

F. Forming: Use continuous end rolling method. No end laps on panels. No portable roll-forming machines will be permitted on this project, no installer-owned or installer-rented machines will be permitted. It is the intent of the Architect to provide Factory-Manufactured panel systems only for this project.

2.2 ACCEPTABLE MANUFACTURERS

A. This project is detailed around the roofing product of Petersen Aluminum Corporation Petersen Aluminum Corp, Andover, MN 877-571-2025, Snap Clad.

2.3 MATERIALS AND FINISHES

A. Preformed roofing panels shall be fabricated of 22 GA Steel

B. Color shall be as approved by owner.

C. Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over a 0.25 to 0.3 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil, to meet AAMA 621. Bottom side shall be coated with a primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.

D. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.

E. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.

F. Closures: use composition or metal profiled closures at the top of each elevation to close ends of the panels. Metal closures to be made in the same material and finish as face sheet.

G. Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates.

H. Substrate shall be Plywood

I. Roofing Underlayment

1. On all surfaces to be covered with roofing material, furnish and install a 40 mil "Peel & Stick membrane", required as outlined by metal panel manufacturer. Membrane to be a minimum of 40 mil thickness, smooth, non-granular, by one of the following manufacturers:
   a. W.R Grace "Ice & water Shield"
   b. Cetco Strongseal
   c. Carlisle CCW WIP 300HT
   d. Interwrap Titanium PSU
   e. MFM Corp "Wind & Water Shield"
   f. Polyguard Deck Guard HT of Polyglas HT
   g. Tamko TW Tile and Metal Underlayment
2. Underlayment shall be laid in horizontal layers with joints lapped toward the eaves a minimum of 6", and well secured along laps and at ends as necessary to properly hold the felt in place. All underlayment shall be preserved unbroken and whole.
3. Ice and Water Shield shall lap all hips and ridges at least 12" to form double thickness and shall be lapped 6" over the metal of any valley or built-in gutters and shall be installed as required by the Standing Seam Panel Manufacturer to attain the desired 20 Year Weathertightness Warranty.

J. Sealants

1. Provide two-part polysulfide class B non-sag type for vertical and horizontal joints or
2. one part polysulfide not containing pitch or phenolic extenders or
3. Exterior grade silicone sealant recommended by roofing manufacturer or
4. One part non-sag, gun grade exterior type polyurethane recommended by the roofing manufacturer.

2.4 FABRICATION

A. Comply with dimensions, profile limitations, gauges and fabrication details shown and if not shown, provide manufacturer's standard product fabrication.

B. Fabricate components of the system in factory, ready for field assembly.

C. Fabricate components and assemble units to comply with fire performance requirements specified.

D. Apply specified finishes in conformance with manufacturer's standard, and according to manufacturer's instructions.

2.5 AIRFLOW SYSTEMS

A. Provide complete system to allow for balanced intake and exhaust ventilation with requirements for NFA as indicated on drawings.

1. Ridge: PAC SS Ridge Vent, slope to slope, 24 gage galvanized steel. Include factory fabricated encaps. Color to match metal roof panels.

2. Eave: Pac SS Vented Eave, Attic version. 24 gage galvanized steel. Include factory fabricated encaps. Color to match metal roof panels.

2.6 SNOW RETENTION SYSTEM

A. Provide Colorguard snow retention system with S-5! Clamps. Attachment system to provide attachment to standing seam metal roofs with only minor dimpling of panel seams, without penetrations through roof seams or panels, without use of sealers or adhesives, and without voiding roof warranty. Install system in accordance with manufacturer's instructions and approved shop drawings.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine alignment of structural steel and related supports, primary and secondary roof framing, solid roof sheathing, prior to installation.
B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FASTENERS

A. Secure units to supports

B. Place fasteners as indicated in manufacturer's standards.

3.3 INSTALLATION

A. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years successful experience with similar applications.

B. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation.

C. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.

3.4 DAMAGED MATERIAL

A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

END OF SECTION

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SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flashings and counter flashings, gutters and downspouts, fabricated sheet metal items, and precast concrete splash pads

1.2 REFERENCES

A. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
B. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate.
C. ASTM A361/A361M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Roofing and Siding.
D. ASTM A446/A446M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
E. ASTM A526/A526M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
F. ASTM B101 - Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction.
G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
H. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
I. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
J. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
K. ASTM D2178 - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
L. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos Free.
M. FS L-P-512 - Plastic Sheet (Sheeting), Polyethylene.
N. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant
O. CDA (Copper Development Association) - Copper in Architecture - Handbook.
P. SMACNA (Sheet Metal and Air Conditioning Contractors National Association) - Architectural Sheet Metal Manual.

1.3 DESIGN REQUIREMENTS

A. Sheet Metal Flashings: Conform to the criteria of SMACNA "Architectural Sheet Metal Manual".

B. Gutter and Downspout Components: Conform to applicable code for size and method of rain water discharge.

1.4 SUBMITTALS FOR REVIEW

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Product Data: Provide data on prefabricated components.

C. Samples: Submit two samples illustrating typical seam, external corner, internal corner, valley junction to vertical dissimilar surface, material and finish.

D. Submit two samples 3 x 6 inch size illustrating metal finish color.

1.5 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years documented experience.

1.6 PRE-INSTALLATION MEETING

A. Convene two weeks before starting work of this section.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Section 01600 - Material and Equipment: Transport, handle, store, and protect.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials that may cause discoloration or staining.

1.8 PROJECT CONDITIONS

A. Coordinate with the work of other Sections.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Pre-Finished Galvanized Steel Sheet: ASTM A755/A755M; structural steel sheet, G90 zinc coating; 0.024 inch thick core steel, shop pre-coated with two coat fluoropolymer top coat; color as selected from manufacturer's standards.

B. Pre-Finished Aluminum Sheet: ASTM B209, 5005 alloy, H34 temper; 0.040 inch thick

C. Stainless Steel: ASTM A167, Type 304, soft temper, 0.015 inch thick; smooth No. 2D finish.

2.2 ACCESSORIES

A. Concealed Fasteners

B. Exposed Fasteners: Same material and same finish as flashing material, with soft neoprene washers.

C. Primer: Zinc molybdate type.

D. Protective Backing Paint: C-494, Bituminous.

E. Sealant: Type specified in Section 07900.

F. Bedding Compound: Butyl.

G. Surface mounted reglets: galvanized steel, rigid extruded PVC; face ends covered with plastic tape. Drive Lock DLR625 manufactured by W.P. Hickman or approved equal.

H. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment

2.3 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate continuous cleats of same material as sheet, interlocking with sheet.

C. Form pieces in 10-foot lengths.

D. Hem exposed edges on underside ½ inch; miter and seam corners.

E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

F. Fabricate corners from one piece with minimum 60 inch long legs; seam for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

H. Fabricate flashings to allow toe to extent 2 inches over roofing gravel or paver. Return and brake edges.

I. Fabricate sheet metal pans (pitch pockets) 6-inch nominal size, with 3-inch upstand, and 4-inch flanges.

J. Factory weld coping cover miters, transitions and end caps prior to finishing.

K. Seal metal joints watertight.

L. Fabricate gutters to rectangular profile. 24 gage prefinished galvanized steel, 5-inch, Style A.

M. Fabricate downspouts to circular profile. 24 gage prefinished galvanized steel, 4-inch, diameter

N. Fabricate accessories in profile and size to suit gutters and downspouts.
1. Anchorage Devices: Type recommended by fabricator.
2. Gutter Supports: Brackets
3. Downspout Supports: Straps.

2.4 FACTORY FINISHING

A. Exposed Finish: AAMA 2605; minimum two coat fluoropolymer coating with minimum 70 percent polyvinylidene fluoride resin (Kynar 500). Color: Chosen from std. color chart.

B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Replace all deteriorated existing wood blocking and add new pressure treated wood blocking as necessary to conform to new roof details.

B. Install started and edge strips, and cleats before starting installation.

C. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

D. Paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mils.

3.3 INSTALLATION

A. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate in profiles.

B. Seal metal joints watertight.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Control: Field inspection.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

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SECTION 07840

FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes firestopping and through-penetration protection system materials and accessories; firestopping tops of fire rated walls; and smoke sealing at joints between floor slabs and interior walls.

1.2 REFERENCES

A. ASTM International:
1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

C. National Fire Protection Association:
1. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:
1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

1.3 DEFINITIONS

A. Firestopping: Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to applicable code UL for fire resistance ratings and surface burning characteristics.

1.5 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on product characteristics, performance and limitation criteria.

C. Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Manufacturer's Installation Instructions: Submit preparation and installation instructions.

E. Manufacturer's Certificate: Certify products meet or exceed applicable code requirements.

F. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.6 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
   1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.

B. Fire Resistant Joints in Fire Rated Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

C. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

D. Perform Work in accordance with State of Illinois and Lake County standards.

1.7 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, and approved by manufacturer.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Apply products in strict conformance with manufacturer’s instruction.

B. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 FIRESTOPPING

A. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

1. Ceramic-Fiber and Mastic Coating:
   a. FireMaster Bulk and FireMaster Mastic, Thermal Ceramics.
2. Ceramic-Fiber Sealant:
   a. Metacaulk 525, The RectorSeal Corporation.
3. Endothermic, Latex Sealant:
   a. Frye-Shield, Tremco, Inc.
4. Endothermic, Latex Compounds:
   a. Flame-Safe FS500/600 Series, International Protective Coatings Corp.
   b. Flame-Safe FS900/FST900 Series, International Protective Coatings Corp.
5. Intumescent Latex Sealant:
   a. Metacaulk 950, The Rector Seal Corporation.
   b. Fire Barrier CP 25WB Caulk, 3M Fire Protection Products.
   c. Tremstop WBM, Tremco, Inc.
6. Intumescent Putty:
   a. Pensil 500 Intumescent Putty, General Electric Co.
   b. Flame-Safe FSP1000 Putty, International Protection Coatings Corp.
   c. Fire Barrier Moldable Putty, 3M Fire Protection Products.
   d. Temstop FP, Tremco, Inc.
7. Intumescent Wrap Strips:
   a. Fire Barrier FS-195 Wrap/Strip, 3M Fire Protection Products.
   b. Tremstop M, Tremco, Inc.
8. Job-Mixed Vinyl Compound:
   a. USG Firecode Compound, United States Gypsum Co.
9. Mortar:
   a. K-2 Firestop Mortar, Bio Fireshield, Inc.
   b. Novasit K-10 Firestop Mortar, Bio Fireshield, Inc.
   c. KBS-Mortar Seal, International Protective Coatings Corp.
10. Pillows/Bags:
   a. Firestop Pillows, Bio Fireshield, Inc.
   b. KBS Sealbags, International Protective Coatings Corp.
   c. Tremstop PS, Tremco, Inc.
11. Silicone Foams:
   a. Dow Corning Fire Stop Foam 2001, Dow Corning Corp.
   b. Pensil 200 Foam, General Electric Co.
12. Silicone Sealants:
   a. Dow Corning Firestop Sealant 2000, Dow Corning Corp.
   b. Dow Corning Firestop Sealant SL 2003, Dow Corning Corp.
   c. Pensil 100 Firestop Sealant, General Electric Co.
   d. CS240 Firestop Sealant, Hilti Construction Chemicals, Inc.
   e. Metacaulk 835, The RectorSeal Corporation.
   f. Fyre-Sil, Tremco Inc.
   g. Fyre-Sil SL, Tremco Inc.
13. Solvent-Release Curing Intumescent Sealants:

a. Biostop 500 Intumescent Firestop Caulk, Bio Fireshield, Inc.
b. Fire Barrier CP 25N/S Caulk, 3M Fire Protection Products.
c. Fire Barriers CP 25S/L Caulk, 3M Fire Protection Products.
d. Tremstop WBM, Tremco, Inc.

2.2 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS:

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements in this section applicable to fire-resistive joint sealants.

B. Sealant Colors: Provide color of exposed joint sealants to comply with the following:
1. Provide selections made by Architect from manufacturer's full range of standard colors for products by type indicated.

C. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to the following:
1. Single-Component, Neutral-Curing, Silicone Sealant:
a. Dow Corning 790, Dow Corning Corp.
b. Dow Corning 795, Dow Corning Corp.
c. Silpruf, General Electric Co.
d. Spectrum 1, Tremco, Inc.
e. Ultraglaze, General Electric Co.
f. 864, Pecora Corp.
2. Multicomponent, Nonsag, Urethane Sealant:
a. Vulkem 922, Mameco International Inc.
b. Dynflex, Pecora Corp.
c. Dynatred, Pecora Corp.
d. Dynatrol II, Pecora Corp.
e. Sikaflex 2cn NS, Sika Corp.
f. Sonolastic No 2, Sonneborn Building Products Div., ChemRex Inc.
g. Dymeric 511, Tremco, Inc.
3. Single-Component, Nonsag, Urethane Sealant:
a. Dymonic, Tremco, Inc.
b. Isoflex 880 GB, Harry S. Peterson Co., Inc.
c. Isoflex 881, Harry S. Peterson Co., Inc.
d. Vulkem 921, Mameco International Inc.
e. Sikaflex-15LM, Sika Corp.

2.3 ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
1. As recommended by manufacturer for substrate material.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with installer present, for compliance with requirements for opening configurations, penetrating items, substrates and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
   1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
   2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

D. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

E. Compress fibered material to maximum 40 percent of its uncompressed size.

3.3 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparing sealant substrate surfaces.

B. Sealant and backing.

1.2 REFERENCES

A. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

B. ASTM D1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).

C. ASTM C790 - Use of Latex Sealing Compounds.

D. ASTM C804 - Use of Solvent-Release Type Sealants.

E. ASTM C834 - Latex Sealing Compounds.

F. FS TT-C-00598 - Caulking Compound, Oil and Resin Base Type.

G. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type.

H. FS TT-S-00227 - Sealing Compound: Elastomeric Type, Multi-Component.

I. FS TT-S-00230 - Sealing Compound: Elastomeric Type, Single Component.

J. FS TT-S-001543 - Sealing Compound: Silicone Rubber Base.

K. SWI (Sealing and Waterproofers Institute) - Sealant and Caulking Guide Specification.

1.3 SUBMITTALS

A. Submit product data under provisions of Division 1.

B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability. Identify sealant by type as indicated in paragraph 3.6. SCHEDULE.

C. Submit samples under provisions of Section 01330.

D. Submit two sets of samples illustrating colors. Color selected by Engineer.

E. Submit manufacturer's installation instructions under provisions of Section 01330.

F. Submit manufacturer's certificate under provisions of Section 01330 that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

B. Applicator: Company specializing in applying the work of this Section with minimum three years experience and approved by sealant manufacturer.

C. Conform to Sealant and Waterproofers Institute requirements for materials and installation.

1.5 FIELD SAMPLES

A. Provide samples under provisions of Division 1.

B. Locate where directed.

C. Accepted sampled may remain as part of the Work.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install solvent curing sealants in enclosed building spaces.

B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate work under provisions of Division 1.

B. Coordinate the work of this Section with all Sections referencing this Section.

1.8 WARRANTY

A. Provide two year warranty under provisions of Section 01700.

B. Warranty: Include coverage of installed sealants and accessories that fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 SEALANTS

A. Type 1: One-Part Acrylic Terpolymer, Nonsag: FS TT-S-00230, Type II, Class A; Mono Manufactured by Tremco; or approved equal.

B. Type 2: One-Part Polysulfide, Nonsag, Not Immersible: FS TT-S-00230, Type II - non-sag, Class A; Sonolastic One Manufactured by Sonneborn; or approved equal.

C. Type 3: Multi-Part Polysulfide, Immersible: FS TT-S-00227, Type II - non-sag, I - self-leveling, Class A; Sonolastic Two Manufactured by Sonneborn; or approved equal.

D. Type 4: One-Part Polyurethane, Not Immersible: FS TT-S-00230, Type II - non-sag, I - self-leveling, Class A; Sonolastic NP-I Manufactured by Sonneborn; or approved equal.

E. Type 5: One-Part Polyurethane, Immersible: FS TT-S-00230, Type II - non-sag, I - self-leveling, Class A; Vulkem 116 Manufactured by Mameco International; or approved equal.

F. Type 6: Mildew Resistant Silicone: FS TT-S-01543, Class A, No. 786 manufactured by Dow Corning; Sanitary 1700 manufactured by General Electric, or approved equal.

G. Type 7: One-Part Silicone, Nonsag, Not Immersible: FS TT-S-01543, Class A, No. 790 manufactured by Dow Corning; or approved equal.

H. Type 8: Not Used.

I. Type 9: Multi-Part Polyurethane, Nonsag, Not Immersible: FS TT-S-00227, nonsag Type II, Mameco International Vulkem 227; or approved equal.

J. Type 10: Multi-Part Polyurethane, Nonsag, Immersible: FS TT-S-00227E, nonsag Type II, Class A; ANSI / NSF 61 approved for contact with potable water; Sikaflex –2c NS, Sonneborn Sonolastic NP-II; or approved equal.

K. Type 11: Butyl Sealant, FS-TT-S-001657, Type I; Red Devil 0697/AG; or approved equal.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: ANSI/ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width; type FT manufactured by Progress Unlimited; Ethafoam SB manufactured by Dow Corning; Sonofam manufactured by Sonneborn; or approved equal.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.

B. Beginning of installation means installer accepts existing surfaces and substrate.

3.2 PREPARATION

A. Clean and prime joints in accordance with manufacturer's instructions.

B. Remove loose materials and foreign matter that might impair adhesion of sealant.

C. Verify that joint backing and release tapes are compatible with sealant.

D. Perform preparation in accordance with ASTM C804 for solvent release, C790 for latex base sealant.

E. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION

A. Install sealant in accordance with manufacturer's instructions.

B. Measure joint dimensions and size materials to achieve 2:1 width/depth ratios.

C. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.

D. Install bond breaker where joint backing is not used.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

G. Tool joints concave.

3.4 CLEANING AND REPAIRING

A. Clean adjacent soiled surfaces.

B. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 PROTECTION OF FINISHED WORK

A. Protect sealants until cured.

3.6 SCHEDULE

	Location	Sealant Type
A.	Expansion/Contraction and Control Joints at:	
	Concrete Walls	7
	Concrete Floor Slabs	5
	Masonry Walls	7
	Ceramic Tile Floors	6
	Ceramic Tile Walls	6
	Exterior Insulation Finish System	7
B.	Material Joints at:	
	Metal Door, Window, and Louver Frames (Exterior)	7
	Metal Door, Window, and Louver Frames (Interior)	7
	Wall Penetrations (Exterior)	7
	Wall Penetrations (Interior)	7
	Floor Penetrations	5
	Ceiling/Roof Penetrations	7
	Sheet Metal Flashings	7
	Precast Concrete Wall Panels (Exterior)	7
	Precast/Prestressed Floor Panels (Interior)	5
	Precast/Prestressed Floor and Roof Panels (Interior)	5
	Preformed Metal Panels	7
C.	Other Joints:	
	Threshold Sealant Bed	4
	Immersed Concrete (Vertical and Sloped, not in contact with potable water)	5
	Immersed Concrete (Horizontal, not in contact with potable water)	5
	Between Counter Tops and Back-splashes	6
	Around Plumbing Fixtures	6
	Immersed Concrete (Vertical and Sloped, in contact with potable water)	10
	Immersed Concrete (Horizontal, in contact with potable water)	10

END OF SECTION

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SECTION 08150

FIBERGLASS (FRP) DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fiberglass doors and frames.

B. Anchors, brackets, and attachments.

1.2 REFERENCES

A. ASTM C236 - Test method for steady-state thermal performance of building assemblies by means of a guarded hot box.

B. ASTM E413, ASTM E90 - Classification for determination of sound transmission class.

C. NFPA 80 - Fire doors and windows.

D. NFPA 252 - Fire tests of door and assemblies.

E. ASTM E152 - Methods of fire tests of door assemblies.

F. UL 10B - Fire tests of door assemblies.

G. SD1 100

1.3 SUBMITTALS

A. Submit shop drawings to indicate door and frame elevations, internal reinforcement, closure method, cutouts for glazing, louvers, and hardware reinforcement, finish and anchoring methods.

B. Submit certified statement from manufacturer that door and frame furnished meets or exceeds requirements specified herein.

C. Submit installation instructions as provided by manufacturer.

D. Submit shop drawings, certifications, and warranty manufacturer's installation instructions under provisions of Division 1.

E. Submit two (2) sets of finish and color samples.

1.4 QUALITY ASSURANCE AND WARRANTY

A. Conform to the requirements of ANSI/SDI-100.

B. Warranty of 5 years for failure due to corrosion.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 3 years of documented experience.

1.6 REGULATORY REQUIREMENTS

A. Flame spread: All FRP component parts, may have a flame spread classification of 25 or less per ASTM E84 and shall be self extinguishing per ASTM E635 or D635 unless operating conditions dictate otherwise.

1.7 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered to the site in sealed, undamaged containers fully identified with the manufacturer's name, project number, the tag location, the door type, color and weight.

B. Store doors and frames at the building site under cover. If the door wrapper becomes wet, remove immediately. Store vertically with the least possible angle. Do not stack horizontally.

C. Deliver, handle, store, and protect under provisions of section 01600.

1.8 COORDINATION

A. Coordinate the work with wall opening construction, door, frame and door hardware installation.

1.9 FIELD MEASUREMENTS

A. Verify the field measurements are as shown on shop drawings.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Products of the following manufacturers or equal, meeting these specifications maybe used on this project:
   1. Special-Lite, Decatur, MI; (269) 423-7068; AF-100
   2. Fenestra Corp., Corrim Polymer door, Conroe, TX; (409) 756-3667.
   3. Chem-Pruf Door Co., Brownsville, Texas; 1-800-444-6924.
   4. Edgewater FRP Door, Oshkosh, WI; 920-235-1992; E-S Series

2.2 MATERIALS

A. Fiberglass mat: Random glass fiber mat, minimum 4.5 ounces per square foot weight of glass material.

B. Polyurethane Foam: Minimum density 4 pounds per cubic foot, maximum flame spread 25 in accordance with ASTM E 84.

C. Kraft Honeycomb Material: Phenolic resin impregnated, maximum flame spread 25 in accordance with ASTM E 84.

D. Roving: Unidirectional glass fiber mat, minimum 16 ounces per square yard weight.

E. Resins: Formulated for specified environment, maximum flame spread 25 in accordance with ASTM E 84.

F. Anchors: Manufacturer’s standard stainless steel fasteners.

G. Bonding Materials: Manufacturer’s standard frame-to-opening bonding system.

H. Glazing: Type specified in Section 08800, factory installed, if requested.

I. Joint Sealer: Silicone sealant, specified in Section 07900.

2.3 DOORS

A. Grades and models as specified per SDI 100.

2.4 FRAMES

A. Frames shall be constructed from fiberglass component parts and materials and be in accordance with the manufacturer's standard method of construction.

B. Frames shall be reinforced with anchor blocks and prepared for the attachment of hinges, closer units, panic exit devices and any other pertinent hardware. When required, mortises for the hinges shall be prepared by the factory unless specific requirements for field installation are noted. All hardware reinforcements will be made for polymer materials unless alternates are approved.

2.5 DOOR CONSTRUCTION

A. FRP door panels shall be made of fiberglass reinforced plastics (FRP) using resins and reinforcements tailored to corrosive environment. Door panel shall have a fiberglass content of not less than 25% by weight and all exterior surfaces shall be treated with ultra-violet inhibitors. The door panels shall be flush construction having no seams or cracks. All mortises shall be provided by the manufacturer. Unless otherwise specified, door thickness shall be nominal 1 3/4".

B. Face Sheets: One continuous piece of FRP material of suitable structural integrity and resin composition to provide a door panel with the ability to perform reliably in the specified environment and physical constraints. Face sheets shall be a maximum of .125" thick unless otherwise specified, with a minimum 15 mils gel coat. A minimum of 2 layers random-fiberglass mat and 1 layer roving - saturated with resins. Chemically bonded to stile/rail structure and core.

C. Core: Kraft honeycomb core material within stile/rail structure. All voids between the door faces shall be completely filled with polyurethane foam.

D. Stiles and Rails: Door panels shall be constructed with the use of a full stile and rail structure. Doors that do not have an engineered stile and rail system are not acceptable. The stile and rail system is to be fabricated entirely from FRP components and shall, of themselves, provide the structural integrity for the door panels. The stile and rail system of itself shall provide an impenetrable barrier between the edge of the door and the core material. The stiles and rail shall provide the primary support for hardware accessories and attachments. (With the exception of height alterations, all alterations to the width or top of doors must be with the manufacturer's explicit approval.) The stiles shall have a minimum of 15 mils gel coat and a minimum 3 layers of random-fiberglass mat saturated with resins.

E. Reinforcements: Door panels shall be adequately reinforced and compression members fabricated from suitable corrosion resistant materials so as to accommodate hinges-(both mortise and surface) closer units, locksets-(both cylindrical and mortise type), kickplates, push pull plate, exit devices, etc.

F. Thru-bolting: Doors shall contain sufficient internal reinforcing in the areas of thru-bolt hardware as specified. Reinforcement shall be corrosion-resistant compression member with the ability to resist typical thru-bolt torquing and maintain the sealed integrity of the panel.

G. Cut-outs: All window lite and louver cut-outs in the door panel shall be supported and sealed so that no moisture or contaminants shall penetrate the door cavity. Louver structures and lites are to be supported by systems that are corrosion resistant of themselves.

2.6 ACCESSORIES

A. Glazing, Glass Lites: Glazing or glass lite support structures shall ensure that the glass area is weathersealed as to not permit moisture and contaminants through. Glazing must allow for ready access for repair, in the event of damage or replacement, without affecting the sealed integrity of the cut-out in the door panel itself.

B. Door Louvers (If Specified): Shall be fabricated from suitable corrosion-resistant, polymer materials and be subject to the same performance guarantee as the door panels.

C. Transoms (If Specified): All transom panels shall be identical to the doors in construction, material thickness, color and reinforcement.

D. Anchors: Frame anchors shall be dictated by the prevailing conditions of the installation and frame units shall be suitably prepared to meet the requirements of the installation.

E. Frames that are fabricated from components parts, shall require that a stop cap be provided to cover any exposed screw heads.

F. Frames that require masonry anchors and tabs shall be suitably prepared to ensure sound and reliable installation.

2.7 FABRICATION

A. Astragals for double doors shaped specifically for double doors.

B. Frames fabricated for knock down field assembly shall provide neatly butted or mitered corner connection.

C. Transom bars for glazed lights: Fixed type, of same profiles as jambs.

D. Prepare frame for 3 single silencers for single doors and center mullions of double doors on strike side. Provide 2 single silencers on frame head at double doors without mullions. Silencers provided by Section 08710.

2.8 FINISH

A. Finish For Doors and Frames: Primer with a finished color coat
   1. Painted Finish: Manufacturers standard industrial coating
   2. Thickness: 5 mils
   3. Sheen: Semi-Gloss or Gloss
   4. Impact Resistance per ASTM D 2794: 140 in lbs.

B. Color: The color of the door shall be stated prior to construction and shall be integrally molded as the components are manufactured.

C. Corner mitres of frames shall be sealed with silicone caulk or liquid plastic after installation is completed.

PART 3 EXECUTION

3.1 EXAMINATION

A. All work shall be square and true, free from buckles and warps. Surfaces shall be free from fiber blemishes. All cut edges shall be properly sealed.

3.2 INSTALLATION

A. Install doors and frames in accordance with ANSI/SDI-100.

B. Coordinate installation of glass and glazing.

C. Install door louvers, plumb and level.

D. Coordinate with wall construction for anchor placement.

E. Coordinate installation of doors and hardware specified in Section 08710.

END OF SECTION

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SECTION 08305

FLOOR ACCESS DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Floor access doors and frame units.

1.2 DESIGN REQUIREMENTS

A. Fabricate floor access doors to support their load rating with deflection not to exceed 1/180.

1.3 SUBMITTALS

A. Submit in accordance with Division 1.
   1. Shop Drawings: Indicate exact position of all access units.
   2. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, fire resistance ratings, and installation details.
   3. Manufacturer's Installation Instructions: Indicate installation requirements, and rough-in dimensions.

1.4 QUALITY ASSURANCE

A. Where fire rated assemblies are required, perform work in accordance with UL requirements, and NFPA 80.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The Bilco Company, New Haven, CT.

B. Halliday Products, Orlando, FL.

C. Xylem – Flygt, Pewaukee, WI.

2.2 PRODUCTS

A. Floor Access Hatch:
   1. Configuration: Angle frame.
   2. Load Rating: 300 PSF.
   3. Materials of construction:
      a. Hatch and Frame: ¼ inch aluminum, diamond plate cover.
      b. Hardware: 316 stainless steel.
   4. Components:
      a. Heavy duty hinges with stainless steel pins.

b. Slam lock with removal handle.
c. Recessed hasp with a hinged cover for a padlock.
d. Compression spring operators.
e. Automatic hold-open arm with release lever.
f. Bituminous paint on surfaces in contact with concrete.

B. Safety Grate:
1. Provide a protective grate for each floor access hatch.
2. Load Rating: 300 PSF.
3. Materials of construction:
a. Grate: 1-inch aluminum “I” bar grating.
b. Hardware: 316 stainless steel.
4. Components:
a. Hinged with stainless steel bolts.
b. Positive latch to maintain unit in an upright position.
c. Safety orange powder coating.
d. Grate openings shall allow for visual inspection and maintenance.

2.3 FABRICATION

A. Form frame perimeter with a closed gutter and drain coupling for connection to drain.

B. Weld, fill, and grind joints to assure flush and square unit.

2.4 FINISHES

A. Base Metal Protection: Prime coat units with baked on rust inhibitive electrostatic enamel primer.

B. Stainless Steel: Provide stainless steel, #4 satin finish, where indicated on drawings.

C. Aluminum: Mill finish.

PART 3 EXECUTION

3.1 INSTALLATION

A. Verify that rough openings for door and frame are correctly sized and located.

B. Install units in accordance with manufacturer's instructions.

C. Install frames plumb and level in opening. Secure rigidly in place.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes door hardware, and all related accessories necessary for a complete hardware installation.

B. See Schedule at end of this Section for components required on this Project. (Components specified but not scheduled may be required for cutting, patching or repair.)

C. The work of this Section is governed by Division 01 of these specifications.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A156 - Complete Series of 24 BHMA Standards.

B. National Fire Protection Association:
   1. NFPA 80 - Standard for Fire Doors, Fire Windows.
   2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

C. Underwriters Laboratories Inc.:
   1. UL 10B - Fire Tests of Door Assemblies.
   2. UL 305 - Panic Hardware.
   3. UL - Building Materials Directory.

D. Warnock Hersey:
   1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide door hardware listed by UL or Warnock Hersey, or other testing laboratory approved by applicable authorities and tested in accordance with NFPA 252.

B. Accessible Openings: Provide door hardware to meet the requirements of ANSI 117.1 Section 404.

1.4 SUBMITTALS

A. Schedule: Provide detailed hardware schedule listing all hardware and accessories for each opening.

B. Product Data: Provide manufacturer’s literature detailing specifications for each hardware component. Include compliance with standards and tests.

C. Shop Drawings:
   1. Indicate locations and mounting heights of each type of hardware, and provide electrical characteristics and connection requirements where applicable.
   2. Submit manufacturer's parts lists, templates and installation instructions.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following requirements:
   1. ANSI A156 series. (BHMA standards)
   2. NFPA 80. (Fire doors)
   3. UL 305. (Panic Hardware)
   4. ANSI 117.1 Section 404 (Accessible Doors)
   5. NFPA 101 Chapter 5 (Life Safety, Exit Doors)

1.6 QUALIFICATIONS

A. Hardware Supplier: Company specializing in supplying commercial and institutional door hardware with minimum five years experience.

B. All keying to be provided by Gappa Security Solutions, LLC. Waupun, WI.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

B. Include persons involved with installation of doors, frames, and hardware.

C. Record and distribute attendance and items discussed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.9 COORDINATION

A. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
   1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

B. Sequence installation to accommodate required utility connections.

C. Coordinate Owner's keying requirements during course of Work.

1.10 WARRANTY

A. Furnish two-year manufacturer warranty for locksets and door closers.

1.11 MAINTENANCE MATERIALS

A. Furnish special wrenches and tools applicable for Owner's general maintenance of each different hardware component.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Hardware Item	Acceptable Manufacturers
Hinges	McKinney, Stanley, Hager
Lockset	Adams-Rite, Best
Latchset	Adams-Rite, Best
Exit Devices	Von Duprin
Electric Strikes	Adams Rite, Folger Adam
Cylinders	Match those used in existing hardware.
Push/Pulls	Vistawall, Quality, Ives
Top &Bottom Bolts	Adams Rite, Glynn-Johnson, Ives
Dust-Proof Strikes	Quality, Glynn-Johnson, Ives
Surface Bolt	Ives
Closers	LCN, Norton, MBS, ASM
Overhead Stops, Holders	Glynn-Johnson, Ives
Electromagnetic Hold-Open	LCN, Rixson
Power Assist Operator	LCN, Horton
Door Stops	Quality, Glynn-Johnson, Ives
Seals, Gaskets, Thresholds, Astragals	Pemko, NGP, Zero, Reese, ASM
Protective Plates	Hager, Trimco or equal
Lock Protectors	ASM, Glynn-Johnson, Ives
Key Cabinets	KCS, Telkee, Lund

2.2 GENERAL PRODUCT REQUIREMENTS

A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.

1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
2. Substrate Reinforcing/Preparation: Furnished by general contractor; coordinated by hardware supplier or hardware manufacturer.
3. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
4. Fasteners and Mounting Plates: Furnish as recommended by hardware manufacturer, as required to secure hardware, and as required by job conditions.
   a. Material: Non-ferrous or corrosion resistant steel.
   b. Finish: Match hardware item being fastened.
5. Fire Ratings: Provide hardware with UL or Warnock Hersey listings for type of application involved.
6. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

2.3 HINGES AND PIVOTS

A. Butt Hinges: ANSI A156.1, full mortise type.

1. Widths: Sufficient to clear trim projection when door swings 180 degrees.
2. Pins: Furnish nonferrous hinges with non-removable pins (NRP) at exterior and locked outswinging doors, non-rising pins at interior doors.
3. Tips: Flat button tips with matching plug.
4. Schedule:

Height of Door	Number of Hinges	Height of Hinges
Up to 60”	2	3½
Up to 90”	3	4½
Up to 120”	4	5

Width of Door	Thickness of Door	Width of Hinges	Bearings	Knuckles
Up to 36” (interior)	Up to 1⅜”	3½”	plain	2
Up to 36”	Up to 1¾”	4½”	2 ball	5
Up to 48” (interior)	Up to 1¾”	4½”	4 ball	5
Up to 48”	Up to 2¼”	5”	4 ball	5

B. Pivots: ANSI A156.1 offset full mortise pivots.
   1. Size: As recommended by pivot manufacturer for size, weight and application of door.

2.4 OPERATORS

A. Locksets/Latchsets: Furnish locksets compatible with specified cylinders. Typical 2-3/4 inch (70 mm) backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt. Verify type of cutouts provided in metal frames.
   1. Bored (Cylindrical) Locksets: ANSI A156.2; Series 4000, Grade 1 unless otherwise indicated.
   2. Product: Best Lock 9K Series with 15K trim or approved equal.

B. Exit Devices: ANSI A156.3, Grade 1 concealed vertical rod type for double doors and rim type for single doors, with push pad (paddle), unless otherwise indicated. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, with dust-proof floor strikes.
   1. Types: Suitable for doors requiring exit devices.
   2. Coordinators: Furnish overhead type at pairs of doors, if required.

C. Electric Strikes: ANSI A156.5 mortised electric strikes.

D. Cylinders: ANSI A156.5, Grade 1, 7 pin type interchangeable core type cylinders.
   1. Keying: Keyed as directed by Owner. All exterior locks keyed alike. All interior locks keyed alike.

E. Meet with OWNER to finalize keying requirements and obtain final instructions in writing.

F. Push/Pulls: ANSI A156.6; push plates minimum 0.050 inch (1.27 mm) thick. Furnish pulls with round whole section with bolts to secure from opposite door face; furnish with minimum 0.050 inch (1.27 mm) pull and push plates with beveled edges four sides unless otherwise indicated.

G. Bolts: ANSI A156.16 Grade 1 top and bottom flush bolts, with dust-proof floor strike, unless otherwise indicated.

2.5 CLOSERS AND DOOR CONTROL DEVICES

A. Manufacturers:
   1. As listed above
B. Comply with ANSI A156.4.
C. Size of Units: Except as otherwise specifically indicated, comply with manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, and anticipated frequency of use.
D. Provide nonparallel arms for overhead closers, except as otherwise indicated.
E. Where parallel arms indicated for closers, provide closer unit one size larger than recommended for use with standard arms.
F. Provide closers for door that open greater than 110 degrees with de-acceleration function.

G. Access-Free Manual Closers: Where manual closers indicated for doors required to be accessible to physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.

H. Provide units designed to hold door in open position under normal usage.

I. Stops
   1. Wall Stops: ANSI A156.1, Grade 1, 3 inch (75 mm) wall stop convex pad wall stop with no visible screws.
   2. Floor Stops: ANSI A156.1 Grade 1 standard floor type with no visible screws; furnish with accessories as required for applications indicated.
   3. Crash Chain: heavy duty, storm type.

2.6 SEALS AND THRESHOLDS

A. Seals
   1. Weatherstripping: Furnish continuous weatherstripping at top and sides of exterior doors.
   2. Fire Rated Gaskets: Furnish continuous fire rated gaskets at top and sides of fire rated doors.
   3. Sound, Smoke and Vapor Seals: Furnish continuous seals at top and sides of doors where scheduled.
   4. Seals shall be replaceable, compressible, molded neoprene (ASTM D2000) or molded PVC (ASTM D2287).
   5. At Door Bottoms: Furnish bottom seals where weatherstripping, gaskets or seals are required AND where thresholds are provided. Furnish automatic door bottoms on doors where scheduled.
   6. At Double Doors: Furnish seals at meeting styles (or an astragal if provided) where weatherstripping, gaskets or seals are required.

B. Thresholds: Maximum 1/2 inch (12 mm) height, unless otherwise indicated.

2.7 MISCELLANEOUS

A. Kickplates: Mop Plate, Armor Plate, Door Edging: ANSI A156.6, metal; size indicated in Schedule (kickplate 1 inch (25 mm) less than door width.) Minimum thickness:
   1. 0.050 inch (1.27 mm) thick stainless steel

2.8 HARDWARE FINISHES

A. Provide matching finishes for hardware units at each door or opening, to greatest extent possible, except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where base metal or metal forming process is different for individual units of hardware exposed at same door or opening. In general, match items to manufacturer's standard finish for latch and lock set (or push-pull units if no latch-lock sets) for color and texture.

B. Provide finishes matching those established by BHMA or, if none established, match ARCHITECT'S sample.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified for applicable units of hardware by referenced standards.

D. Provide protective lacquer coating on exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated. Suffix -NL is used with standard finish designations to indicate no lacquer.

E. Designations used in schedules and elsewhere to indicate hardware finishes are industry-recognized standard commercial finishes, except as otherwise noted.

F. Rust-Resistant Finish: For iron and steel base metal, required for exterior work and in areas shown as high humidity areas and also when designated with suffix -RR, provide 0.2 mil thick copper coating on base metal before applying brass, bronze, nickel or chromium plated finishes.

G. Finish Requirements:
   1. Locksets: US26D.
   2. Hinges: US32D.
   3. Flushbolts: US26D.
   4. Protection Plates: US32D.
   5. Closers: US28.
   6 Exit Devices: US26D.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings.

B. Verify electric power is available to power operated devices and is of correct characteristics.

3.2 INSTALLATION

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Mounting Heights From Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.
   1. Locksets: 40 inch above finished floor, to center line of strike.
   2. Push/Pulls: 42 inch (1 067 mm).
   3. Dead Locks: 48 inch (1 220 mm).
   4. Push Pad Type Exit Devices: 42 inch (1 067 mm).
   5. Cross Bar Type Exit Devices: 38 inch (965 mm) min, 40 5/16 (1,024 mm) max, to center line of strike.
   6. Top Hinge: Jamb manufacturer's standard, but not greater than 10 inches (254 mm) from head of frame to center line of hinge.
   7. Bottom Hinge: Jamb manufacturer's standard, but not greater than 12-1/2 inches (317 mm) from floor to center line of hinge.
   8. Intermediate Hinges: Equally spaced between top and bottom hinges and from each other.
   9. Hinge Mortise on Door Leaf: 1/4 inch (6.35 mm). to 5/16 inch (7.9 mm) from stop side of door.

3.3 FIELD QUALITY CONTROL

A. Suppliers shall inspect installation and certify hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

A. Adjust hardware for smooth operation. Adjust lock/latch easily (not too tight) and hold door firmly (not too loose).

B. Adjust clearances between door and home (1/8 " +/- 1/16").

C. Adjust seals (weather, fire, smoke, sound, vapor) to perform properly. Replace seals which do not perform.

3.5 CLEANING AND PROTECTION

A. Clean completed work.

B. Protect installed hardware and hardware finish from damage until final acceptance.

3.6 SCHEDULE:

Set #	Description	Items Required
#1	Exterior FRP pair	1.5pr Butt Hinges (each leaf) Classroom function Lockset (active leaf) Top & Bottom Bolts (inactive leaf) Closer (each leaf) Weatherstripping (each leaf) Threshold (entire opening) Astragal (inactive leaf) Lock Guard

END OF SECTION

SECTION 08800

GLAZING

1 PART 1 GENERAL

1.1. SECTION INCLUDES

A. Glass and glazing for FRP doors.

1.2. REFERENCES

A. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

B. ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.

C. ASTM C1036 - Flat Glass.

D. ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.

E. ASTM E546 - Test Method For Frost Point of Sealed Insulating Glass Units.

F. ASTM E576 - Test Method For Dew/Frost Point of Sealed Insulating Glass Units in Vertical Position.

G. ASTM E773 - Test Method for Seal Durability of Sealed Insulating Glass Units.

H. ASTM E774 - Sealed Insulating Glass Units.

I. FGMA - Glazing Manual.

J. FGMA - Sealant Manual.

K. FS TT-C-00598 - Caulking Compound, Oil and Resin Base Type.

L. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type.

M. FS TT-S-00227 - Sealing Compound, Rubber Base, Two Component.

N. FS TT-S-00230 - Sealing Compounds, Synthetic-Rubber Base, Single Component, Chemically Curing.

O. FS TT-S-01543 - Sealing Compound, Silicone Rubber Base.

P. FS TT-G-410 - Glazing Compound, Sash (Metal) for Back Bedding and Face Glazing (Not for Channel or Stop Glazing).

Q. Laminators Safety Glass Association - Standards Manual.

R. SIGMA - Sealed Insulated Glass Manufacturers Association.

1.3. PERFORMANCE REQUIREMENTS

A. Glass and glazing materials of this Section shall provide continuity of building enclosure vapor and air barrier:
1. Maintain continuous air and vapor barrier through-out glazed assembly from glass panel to heel bead of glazing sealant.

B. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with The BOCA National Building Code, as measured in accordance with ASTM E330.

C. Limit glass deflection to 1/200 flexure limit of glass with full recovery of glazing materials, whichever is less.

1.4. SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

D. Samples: If requested, submit two samples, 12 x 12 inch in size, illustrating glass units, coloration and design.

E. Samples: Submit 4 inch long bead of glazing sealant. Color as selected by Engineer.

F. Manufacturer's Installation Instructions: Indicate special precautions required.

G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5. QUALITY ASSURANCE

A. Perform Work in accordance with FGMA Glazing Manual, FGMA Sealant Manual, SIGMA and Laminators Safety Glass Association - Standards Manual for glazing installation methods.

1.6. MOCKUP

A. Not required.

1.7. PRE-INSTALLATION CONFERENCE

A. Not required.

1.8. ENVIRONMENTAL REQUIREMENTS

A. Do not install glazing when ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

1.10. COORDINATION

A. Coordinate the Work with glazing frames, wall openings, and perimeter air and vapor seal to adjacent Work.

1.11. WARRANTY

A. Provide ten year manufacturer's warranty.

B. Warranty: Include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

2 PART 2 PRODUCTS

2.1. MANUFACTURERS - FLAT GLASS MATERIALS

A. PPG Industries, Inc.

B. Libbey - Owens - Ford Glass Co.

C. Guardian Industries Corporation.

D. HGP Industries.

E. Approved equal.

2.2. FLAT GLASS MATERIALS

A. Float Glass (Type FG): ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality glazing; 1/4 inch thick.

B. Safety Glass (Type SG): Clear; fully tempered with horizontal tempering; conforming to ANSI Z79.1; 1/4 inch thick.

C. Wire Glass (Type WG): Clear, polished both sides, diagonal mesh of woven stainless steel wire of ½ inch grid size; 1/4 inch thick.

2.3. MANUFACTURERS - SEALED INSULATING GLASS MATERIALS

A. PPG Industries, Inc.

B. Interpane.

C. Cardinal Insulating Glass.

D. Approved equal.

2.4. SEALED INSULATING GLASS MATERIALS

A. Insulated Glass Units (Type IG) ASTM E774 and E773; double pane with, silicone sealant edge seal; outer pane of 1/4 inch glass clear, inner pane of clear glass.

B. Insulated Tempered Glass Units (Type ITG): ASTM E774 and E773; double pane with silicone sealant edge seal; outer pane of 1/4 inch clear tempered glass, inner pane of 1/4 inch clear tempered glass, interpane space purged dry hermetic air; total unit thickness of 1 inch.

C. Plastic: Double glazed units with 1/4 inch air space, transparent bronze tinted sheet outside, clear sheet inside; each sheet 3/16-inch minimum thickness polycarbonate. Use "Lexan 9034" as manufactured by General Electric; or equal.

2.5. FIRE RATED GLAZING

A. 90-Minute Heat Barrier Series frame with Pyrostop Glass, by Technical Glass Products, 800-426-0279, or approved equal.

2.6. GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, EPDM, 80 - 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 - 60 Shore A durometer hardness, minimum 3 inch long x one half the height of the glazing stop x thickness to suit application.

C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 - 15 Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines: Resilient polyvinyl chloride extruded shape to suit glazing

channel retaining slot; color, black.

E. Silicone Sealant: FS TT-S-01543, Class A; single component; capable of water immersion without loss of properties; cured Shore A hardness of 15 - 25; black color.

2.7. SOURCE QUALITY CONTROL AND TESTS

A. Test samples in accordance with ANSI Z97.1.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2. PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

3.3. EXTERIOR - WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

A. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with silicone sealant.

B. Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.

C. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact.

E. Install removable stops with spacer strips inserted between glazing and applied stops, 1/4 inch below sight line.

F. Fill gap between glazing and stop with sealant to depth equal to bit of frame on glazing, but not more than 3/8 inches below sight line.

G. Apply cap bead of sealant along void between the stop and the glazing, to uniform line, flush with site line. Tool or wipe sealant surface smooth.

3.4. INTERIOR - DRY METHOD (TAPE AND TAPE)

A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

D. Place glazing tape on free perimeter of glazing in same manner described above.

E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

F. Knife trim protruding tape.

3.5. QUALITY CONTROL

A. Inspection will monitor quality of glazing.

3.6. CLEANING

A. Clean work under provisions of 01700.

B. Remove glazing materials from finish surfaces.

C. Remove labels after work is complete.

D. Clean glass.

3.7. PROTECTION OF FINISHED WORK

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

B. Replacements and Repairs: Prior to acceptance of buildings, replace broken, defective, or scratched glass and repair damaged compounds.

END OF SECTION

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SECTION 09260

GYPSUM BOARD SYSTEMS

PART 1 GENERAL

1.1. SUMMARY

A. Section Includes:
1. Interior Wallboard Systems Including:
a. Gypsum and cementitious boards.
b. Joint treatment trim and tape.
c. Acoustic Insulation and Sealant.
d. Wallboard accessories.
e. Texture finish.

B. General Requirements: Perform work of this section in accordance with Division One of these specifications.

1.2. REFERENCES

A. ANSI/ASTM C36 - Gypsum Wallboard.

B. ANSI/ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction.

C. ANSI/ASTM C630 - Water Resistant Gypsum Backing Board.

D. ANSI/ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.

C. ANSI/ASTM C646 - Steel Drill Screws for the Application of Gypsum Sheet Material to Light Gage Steel Studs.

D. ANSI/ASTM C754 - Installation of Framing Members to Receive Screw Attached Gypsum Wallboard, Backing Board, or Water Resistant Backing Board.

E. ANSI/ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

F. ANSI/ASTM E119 - Fire Tests of Building Construction and Materials.

G. FS HH-I-521 - Insulation Blankets, Thermal (Mineral Fiber, for Ambient Temperatures).

H. GA-201 - Gypsum Board for Walls and Ceilings.

I. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.

1.3. PERFORMANCE REQUIREMENTS

A. Acoustic Attenuation for Identified Interior Partitions.

1.4. QUALITY ASSURANCE

A. Applicator: Company specializing in gypsum board systems work with three years documented experience.

1.5. REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated assemblies.

1.6. SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 1.

B. Indicate on shop drawings, special details associated with fireproofing and acoustic seals.

C. Provide product data on metal framing, gypsum board, accessories, joint tape and decorative finish.

PART 2 PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS - GYPSUM BOARD SYSTEM

A. US Gypsum Corporation.

B. National Gypsum.

C. Georgia-Pacific.

D. Inryco-Milcor

E. Unimast Inc.

F. Approved equal.

2.2. FRAMING MATERIALS

A. Studs and Tracks: ANSI/ASTM C645; galvanized sheet steel, 25 gage thick, ‘C’ shape, with serrated faces, size as indicated.

B. Furring, Framing and Accessories: ANSI/ASTM C645.

C. Fasteners: ASTM C1002, self-drilling, self-tapping, bugle head screws. Use Type S, 1-inch long for wallboard to sheet metal and Type W, 1-1/4-inch long for wallboard to

wood.

D. Adhesive: ASTM C557.

E. Wood Blocking: Construction grade softwood, fire retardant, moisture resistant treated.

2.3. GYPSUM BOARD MATERIALS

A. Standard Gypsum Board: ANSI/ASTM C36; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.

B. Fire Rated Gypsum Board: ANSI/ASTM C36; fire resistive type, UL rated; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.

C. Moisture Resistant Gypsum Board: ANSI/ASTM C630; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.

D. Foil Faced Gypsum Board: ASTM C36; 5/8 inch thick, maximum permissible length; back surface laminated with aluminum foil; ends square cut, tapered edges.

E. Cementitious Backer Board:
   1. Material: Provide cementitious backer units complying with ANSI A118.9 and in maximum lengths to minimize end-to-end butt joints.
      a. Thickness: 5/8 inch.
      b. Width: Manufacture's standard but not less than 32 inches.
   2. Products:
      a. PermaBase Cement Board, National Gypsum Co.
      b. DUROCK Interior Cement Board, United States Gypsum Co.
      c. Dens-Shield Tile Backer, Georgia Pacific.

F. Finish Schedule

Mark	Description
GWB	Use Standard, Fire Rated or Moisture Resistant as required by application.
GMB-2	Use Cementitious Backer Board (under epoxy or ceramic tile finish).

2.4. ACCESSORIES

A. Acoustical Insulation: FS-HH-I-521; preformed mineral wool, friction fit type without integral vapor barrier membrane, 1-1/2 inch thick.

B. Acoustical Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

C. Corner Beads: Metal; 1-1/4 x 1-1/4 inch; USG Dur-A-Bead.

D. Edge Trim: GA 201 and GA 216; USG 200A, metal trim.

E. Joint Materials: ANSI/ASTM C475; reinforcing tape, joint compound, adhesive, water,

and fasteners.

F. Metal Control Joint: USG No. 093, Gold Bond E-Z strip control joint, or equal.

G. Carrying Channels: Cold-rolled steel, 16 gauge, free of rust, galvanized, 1-1/2 inches deep, weighing not less than 475 pounds per 1,000 linear feet.

H. Furring Channels: Roll-formed hat shaped section of 25 gauge galvanized steel with a face width of 1-3/8 inches and a depth of 7/8 inch.

I. Resilient Furring Channels: Roll-formed section of 25 gauge galvanized steel, ½ inch depth, with 1-1/2 inches designed for resilient attachment of wallboard to framing. Use U.S. Gypsum RC-1 channel or Donn DG-8 resilient channels, or equal.

J. Tie Wire: Galvanized, soft annealed steel, 16 gauge minimum.

K. Hanger Wire: Galvanized, annealed steel, 9 gauge.

2.5. SPRAY TEXTURE

A. Use Sheetrock brand spray texture finish for ceilings; or approved equal. Orangepeel texture.

PART 3 EXECUTION

3.1. INSPECTION

A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on Drawings.

B. Beginning of installation means acceptance of existing surfaces.

3.2. METAL STUD PARTITION INSTALLATION

A. Install studding in accordance with ANSI/ASTM C754.

B. Metal Stud Spacing: 16 inches on center.

C. Partition Heights: To 4 inches above suspended ceilings or full height to floor or roof construction above as indicated on drawings. Install additional bracing for partitions extending above ceiling.

E. Door Opening Framing: Install double studs at door frame jambs. Provide lateral bracing.

F. Blocking: Nail wood blocking to studs. Install blocking for support of plumbing fixtures, wall cabinets, toilet accessories and hardware.

G. Coordinate installation of bucks, anchors, blocking, electrical and mechanical work placed in or behind partition framing.

3.3. WALL FURRING INSTALLATION

A. Erect wall furring for direct attachment to concrete block and concrete walls.

B. Erect wall furring channels vertically. Secure in place on alternate channel flanges at maximum 16 inches on center.

C. Space furring channels maximum 24 inches on center, not more than 4 inches from abutting walls.

D. Install thermal insulation directly attached to concrete masonry and concrete walls in accordance with manufacturer's instructions.

3.4. FURRING FOR FIRE RATINGS

A. Install furring as required for fire resistance ratings indicated.

3.5. CEILING FRAMING INSTALLATION

A. Install in accordance with ANSI/ASTM C754.

B. Coordinate location of hangers with other work.

C. Install ceiling framing independent of walls, columns, and above-ceiling work.

D. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.

E. Laterally brace entire suspension system.

3.6. ACOUSTICAL ACCESSORIES INSTALLATION

A. If called for on the drawings, install resilient channels at maximum 24 inches on center. Locate joints over framing members.

B. Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

C. Install acoustical sealant within partitions in accordance with manufacturer's instructions.

3.7. GYPSUM BOARD INSTALLATION

A. Install gypsum board in accordance with GA 201 and GA 216.

B. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.

D. Double Layer Applications: Use gypsum backing board for first layer, placed perpendicular to framing or furring members. Place second layer parallel to first layer. Offset joints of second layer from joints of first layer.

E. Treat cut edges and holes in moisture resistant gypsum board with sealant.

G. Place control joints consistent with lines of building spaces as indicated.

H. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

3.8. JOINT TREATMENT

A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

B. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.

C. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.

3.9. TEXTURE FINISH

A. Apply finish texture coating in accordance with manufacturer's instructions.

3.10 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers surface preparation, furnishing, and application of architectural paint and special protective coatings.

B. It is the intent that all interior and exterior wood, masonry, concrete, metal, and submerged metal surfaces be painted, whether specifically mentioned or not, except as modified herein. Concealed structural steel surfaces shall receive prime coat only unless modified herein. Exterior concrete surfaces will not be painted unless specifically indicated hereinafter.

C. Abbreviations:

ANSI	American National Standards Institute
AWWA	American Water Works Association
FRP	Fiberglass Reinforced Plastic
HC1	Hydrochloric Acid
MDFT	Minimum Dry Film Thickness
MDFTPC	Minimum Dry Film Thickness Per Coat
mil	Thousandths of an Inch
MIL-P	Military Specification - Paint
OSHA	Occupational Safety and Health Act
PSDS	Paint System Data Sheet
SFPG	Square Feet Per Gallon
SFPGPC	Square Feet Per Gallon Per Coat
SP	Surface Preparation
SSPC	Steel Structures Painting Council

1.2 SURFACES NOT REQUIRING PAINTING

A. Unless otherwise specifically indicated in the Technical Specifications or on the Drawings, the following areas of items will not require painting:

B. Nonferrous, corrosion-resistant metals such as aluminum and stainless steel, except where:

1. Required for electrical insulation between dissimilar metals.
2. Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
3. Color coding of equipment and piping is required.
4. Architectural finish coating is required.

C. Nonmetallic materials such as glass, PVC, FRP, porcelain, and plastic except as required for architectural painting or color-coding.

D. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches, acoustical tile, cabinets, elevators, building louvers, wall panels, prefinished metal roofing, etc., except where specified.

E. Nonsubmerged electrical conduits attached to unpainted concrete surfaces need not be painted.

F. Cathodic protection anodes shall not be painted.

G. Items specified to be hot-dip galvanized after fabrication unless specifically required elsewhere in these Specifications or subject to immersion; manufactured items and materials that are "factory" galvanized shall be prepared and coated as specified hereinafter for the exposure condition of the item and for architectural purposes unless otherwise specified herein; specifications for repair of damaged galvanized surfaces are contained hereinafter.

1.3 REFERENCES

A. ASTM International:
   1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
   2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
   3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association: NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Painting and Decorating Contractors of America: PDCA - Architectural Painting Specification Manual.

D. SSPC: The Society for Protective Coatings: SSPC - Steel Structures Painting Manual.

E. Underwriters Laboratories Inc.: UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.4 DEFINITIONS

A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

1.5 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with at least five years experience.

B. Applicator: Company specializing in commercial painting and finishing with 3 years experience and approved by product manufacturer.

C. Quality Assurance: The paint manufacturer shall provide a representative to visit the jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these Specifications, and as may be necessary to resolve field problems attributable to, or associated with, the manufacturer's products furnished under this Contract.

D. Inspection: The Contractor shall give the Engineer a minimum of 3 days advance notice of the start of any surface preparation work or coating application work. All such work shall be performed only in the presence of the Engineer, unless the Engineer has granted prior approval to perform such work in his absence.

E. For all coatings subject to immersion, full cure must be obtained for the completed system. Consult the coatings manufacturer's written instructions for these requirements. The coating shall not be immersed for any purpose until completion of the curing cycle.

F. Inspection by the Engineer, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.

1.6 TESTS

A. Provide analysis and testing of coating and finish under provisions of Section 01400.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable codes for flame/fuel/smoke rating requirements for finishes.

1.8 SUBMITTALS

A. Submit product data under provisions of Section 01330.

B. Data Sheets:
1. For each paint system used herein, the Contractor shall obtain from each paint manufacturer for submittal to the Engineer, a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system, except for products applied by equipment manufacturers.
2. The required information shall be submitted on a system-by-system basis. The Contractor shall also provide copies of the paint system submittals to the coating applicator. A sample PSDS form is appended at the end of this section. Indiscriminate submittal of manufacturer's literature only will not be accepted.
3. Do not submit PSDS for paint systems not used.

C. Submit manufacturer's application instructions under provisions of Section 01330.

1.9 FIELD SAMPLES

A. Provide samples under provisions of Section 01330.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01600. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.

B. Store and protect products under provisions of Section 01600.

C. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.

E. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 60 percent, unless required otherwise by manufacturer's instructions.

C. Minimum Application Temperatures:
   1. Latex Paints: 50 degrees F unless required otherwise by manufacturer's instructions.
   2. Varnish Finishes: 65 degrees F unless required otherwise by manufacturer's instructions.

D. Provide lighting level of 80 ft candles measured mid- height at substrate surface.

1.12 EXTRA STOCK

A. Provide a one-gallon container of each color and surface texture to Owner.

B. Label each container with color, texture, and room locations, in addition to the manufacturer's label.

PART 2 PRODUCTS

2.1 PAINT AND COATINGS SUPPLIERS

A. The letter code will be found following the generic descriptions of materials outlined in the Specifications. Address given is that of the general offices; contact these offices for information regarding the location of their representative nearest the project site.

1. Supplier Code A - Coatings Suppliers (able to supply most heavy-duty industrial coatings and architectural paints):

Ameron Protective Coatings, Brea, CA.
Carboline Coatings Company, St. Louis, MO.
DuPont Chemical Company, Wilmington, DE.
ICI Paints / Devoe Coatings, Louisville, KY.
International Protective Coatings, Houston, TX.
Plasite, Green Bay, WI.
Rustoleum Corporation, Evanston, IL.
Sherwin Williams, Cleveland, OH.
Tnemec Coatings, Kansas City, MO.
Or equal

2. Supplier Code B - Paint Suppliers (able to supply most architectural and institutional paints):

Ameritone, Long Beach, CA.
Benjamin Moore Paints, Montvale, NJ.
Detroit Graphite Company, Rockford, IL.
Fuller/O'Brien Paint Company, San Francisco, CA.
Glidden Company, Cleveland, OH
Pittsburgh Paints, Pittsburgh, PA.
Pratt and Lambert, Inc., Buffalo, NY.
Samuel Cabot, Inc., Boston, MA.
Standard Dry Wall Products, Inc., Miami, FL.
Or equal

3. Supplier Code C - Specialty Suppliers:

Darworth Company, Avon, CT
Jasco Chemical Company, Mountain View,CA
McCloskey Varnish Company, Philadelphia, PA
Olympic Stain & Varnish, Seattle, WA
Pavey Research Corporation, Tukwila, WA
Rainguard International, Conyers, GA
Sauereisen, Pittsburgh, PA
Tamms Industries, Kirkland, IL
Thoro System Products, Miami, FL
United Coatings, Greenacres, WA
Or equal

2.2 PAINT MATERIALS

A. General: All materials of a paint system, including primer and finish coats, shall be produced by the same paint manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer of the particular coating.

B. Coatings: Ready mixed, except field-catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating. Good flow and brushing properties; capable of drying or curing free of streaks or sags.

C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

D. All products submitted shall conform to federal, state and local requirements limiting the emission of volatile organic compounds.

E. The following paint products are listed according to their approximate order of appearance in the paint systems. Deviations from the specified paint systems must be reviewed by the Engineer before use. The letter designating the supplier code references the listing of paint suppliers able to furnish these specific materials.

Product	**Definition**
Polyamide, Anti-Corrosive, Epoxy	Converted epoxy primer containing rust-inhibitive pigments, min. 50% solids by volume; certified to NSF Std. 61 for potable water service designation Supplier Code: A
Organic Zinc Rich Primer	Converted Epoxy, epoxy/phenolic or urethane type, minimum 14 lbs. metallic zinc content per gallon Supplier Code: A
Rust-Inhibitive Primer	Single-package steel primers with anti-corrosive pigment loading; may be alkyd, polyamide epoxy, epoxy ester, chlorinated rubber, minimum 30% solids by volume Supplier Code: A-B
Wash Primer	Vinyl butyral acid Supplier Code: A
Inorganic Zinc Primer	Solvent or water based, 14 lbs. metallic zinc content per gallon minimum; follow manufacturer's recommendation for top coating Supplier Code: A
Polyamide High Build Epoxy	Percent of volume solids 55% minimum, chemical resistant service. Capability of 4-7 MDFT per coat. Supplier Code: A

Product	Definition
Polyamide Epoxy, High Solids	Percent of volume solids 70% minimum, self-priming, suitable for immersion service; certified to NSF Std. 61 for potable water service designation. Capability of 6-8 MDFT per coat Supplier Code: A
Polyurethane	Two-component, aliphatic or acrylic based polyurethane; high gloss finish, min. 55% solids by volume Supplier Code: A
Epoxy Block Filler	Two component epoxy filler/sealer; min. 70% solids by volume Supplier Code: A-B
Epoxy Floor Primer	Two component epoxy primer/sealer; 100% solids by volume Supplier Code: A-B-C
Epoxy Floor Finish	Two component self-leveling epoxy floor finish; colored, smooth finish; 100% solids by volume Supplier Code: A-B-C
Canvas Sealer	Single-package latex or alkyd primer for canvas surfaces; follow manufacturer's recommendations for surface preparation Supplier Code: A-B
Alkyd Enamel (Semi-Gloss)	High quality, semi-gloss finish, percent of volume solids 45% minimum Supplier Code: A-B
Acrylic Block Filler	Primer-sealer designed for rough masonry surfaces, min. 50% solids by volume Supplier Code: A-B
Sanding Sealer	Co-polymer oil, clear, dull luster Supplier Code: A-B-C
Stain	Satin luster, linseed oil Supplier Code: A-B-C
Varnish	Nonpigmented vehicle based on a variety of resins (alkyd, phenolic, polyurethane) available in gloss, semi-gloss, satin and flat finishes Supplier Code: A-B-C

Product	Definition
Acrylic Latex (Gloss)	High gloss, single-component Supplier Code: A-B
Acrylic Latex (Flat)	Heavy duty exterior grade, single component Supplier Code: A-B
Acrylic Latex (Semi-Gloss)	Semi-gloss, single-component Supplier Code: A-B
Latex / Alkyd Primer/Sealer	Single-package latex or alkyd primer for gypsum or plaster surfaces; follow manufacturer's recommendations for surface preparation Supplier Code: A-B
Waterborne Epoxy Acrylic	Percent of volume solids 40% minimum, two-component waterborne epoxy acrylic, gloss. Supplier Code: A-B
High Solids Water Borne Coating	100% Acrylic Emulsion Coating, 60% solids by weight Supplier Code: A-B-C
Silane-Based Water Repellent Coating	Modified polysilane / siloxane based, breathable, colorless, nonstaining, non-yellowing, deep penetrating concrete / masonry water repellent compound. Rainguard Blok-Lok, Tamms Baracade Silane, or equal. Supplier Code: C

2.3 COLORS

A. Colors to be used are shown on the Drawings and designated hereinafter.

B. Colors shall be formulated with colorants free of lead, lead compounds, or other materials that might be affected by the presence of hydrogen sulfide or other gases likely to be present at the project.

C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply matches.

D. Equipment Colors:

1. In general, mechanical equipment will be shop primed and field finished after installation. Equipment shall be meant to include the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits. All non-submerged portions of equipment shall be painted the color as chosen by the Owner, except as itemized below:

Equipment	Color
Dangerous parts of equipment and machinery	OSHA Orange
Fire protection equipment and apparatus	OSHA Red
Physical hazards in normal operating area	OSHA Yellow

2. Fiberglass reinforced plastic (FRP) equipment with an integral colored gel coat does not require painting, provided the color is as specified.

E. Pipe Identification Painting:
1. All non-submerged metal piping except electrical conduit shall be color-coded. Metal fittings and valves shall be painted the same color as the pipe or a color chosen by the Owner.
2. Piping color-coding shall be in accordance with the Piping Schedule.
3. Fiberglass reinforced plastic (FRP) pipe and polyvinyl chloride (PVC) pipe will not require painting, except as noted for color-coding.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer. Examine surfaces scheduled to be finished before commencement of work. Report any condition that may potentially affect proper application. Beginning of installation means acceptance of existing surfaces and substrate.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Plaster and Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
5. Concrete Floors: 8 percent.

3.2 PROTECTION OF MATERIALS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Openings in motors shall be masked to prevent paint and other materials from entering the motors.

3.3 ENVIRONMENTAL CONDITIONS

A. Paint shall not be applied in temperatures exceeding the manufacturer's recommended maximum and minimum allowable, nor in dust, smoke-laden atmosphere, damp or humid weather.

B. Abrasive blast cleaning shall not be performed whenever the relative humidity exceeds 85 percent, nor whenever the surface temperature is less than 5 degrees F above the dew point of the ambient air.

3.4 SAFETY

A. Painting shall be performed in strict accordance with the safety recommendations of the paint manufacturer; with the safety recommendations of the National Association of Corrosion Engineers contained in the publication, Manual for Painter Safety; federal, state, and local agencies having jurisdiction.

3.5 PREPARATION

A. Remove electrical plates, hardware, light fixture trim, and fittings before preparing surfaces or finishing.

B. Correct minor defects and clean surfaces which affect work of this Section.

C. Shop Blast Cleaning:
   1. Notify Engineer at least 7 days before start of shop blast cleaning to allow the Engineer or his representative to inspect the work during surface preparation and shop application of paints. The work shall be subject to the Engineer's approval before shipment to the jobsite.
   2. Items such as structural steel, metal doors and frames, metal louvers, and similar items as reviewed by the Engineer may be shop prepared and primed at the option of the Contractor. Centrifugal wheel blast cleaning is an acceptable alternate to shop blast cleaning. All work shall be blast cleaned and primed in accordance with these Specifications.
   3. Finish painting at the jobsite shall be as specified herein. If the manufacturer of the finish coating differs from that of the shop primer, Contractor shall provide the Engineer with manufacturer's written confirmation that the materials are compatible.

D. Field Sandblasting: Perform sandblasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, procedures, and safety equipment for personnel shall conform to the Steel Structures Painting Council.

E. Metal Surface Preparation:
   1. All workmanship for metal surface preparation as specified shall be in strict conformance with the current Steel Structures Painting Council (SSPC) Specifications as follows:

Solvent Cleaning	SP 1

Hand Tool Cleaning	SP 2
Power Tool Cleaning	SP 3
White Metal Blast Cleaning	SP 5
Commercial Blast Cleaning	SP 6
Brush-Off Blast Cleaning	SP 7
Near-White Blast Cleaning	SP 10
Power Tool Cleaning to Bare Metal	SP 11
Water-jetting	SP 12

2. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words of equal intent are used in these Specifications or in paint manufacturer's Specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.
3. Hand tool clean areas that cannot be cleaned by power tool cleaning.
4. All oil, grease, welding fluxes, and other surface contaminants shall be removed as a first step in any surface preparation. Pre-blast cleaning methods shall use steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
5. Small isolated areas shall be cleaned as above or solvent cleaned with suitable solvents and clean cloths.
6. The type of equipment and speed of travel shall be such that the specified degree of cleanliness is obtained. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendations for the particular primer to be used.
7. The Contractor shall comply with all applicable federal, state, and local, air pollution and environmental control regulations for blast cleaning, and disposition of spent aggregate and debris.
8. Alternatives to standard abrasive blast cleaning methods will be permitted subject to a review by the Engineer.
9. All surfaces shall be cleaned of all dust and residual particles of the cleaning operations by dry (no oil or water vapor) air blast cleaning or other method before painting. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned.
10. Surfaces shall be painted the same day they are sandblasted. Surfaces that have started to rust before they are painted shall be re-blasted.

F. Concrete Surface Preparation (SP 13):
1. Surface preparation shall not begin until 30 days after the concrete has been placed.
2. Removal all grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
3. Concrete surfaces shall be brushoff blast cleaned to remove all curing compounds and loose concrete to provide a tooth for binding. If brushoff blasting is impractical, horizontal surfaces may be acid etched with muriatic acid solution.
4. Unless otherwise required for proper adhesion, surfaces shall be dry before painting. Moisture content of the concrete shall be 3 lbs/1000sf/24 hours emission or less prior to coating application.

G. Masonry Surface Preparation:
   1. Masonry construction shall be completed and cured for 14 days or more before surface preparation work is started.
   2. All oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter shall be removed by solvent, detergent washing, or other suitable cleaning methods.
   3. Masonry surfaces shall be cleaned of all mortar and grout spillage and other surface deposits using either (1) nonmetallic fiber brushes and commercial muriatic acid followed with rinsing with clean water, or (2) brushoff blasting, or (3) water blasting.
   4. Care shall be taken to avoid damage to the masonry mortar joints or adjacent surfaces.
   5. Surfaces shall be clean and, unless otherwise required for proper adhesion, shall be dry before painting.
   6. Masonry surfaces that are to be painted shall have a uniform texture and be free of surface imperfections that would impair the intended finished appearance.
   7. Masonry surfaces that are to remain uncoated, or are specified to receive a clear coating, shall be free of discolorations and be uniform in texture after cleaning.

H. Plastic Surface Preparation: All plastic surfaces to be coated shall be hand sanded with a medium grit sandpaper to provide tooth for the coating system. Large areas may be power sanded or brushoff blasted, provided sufficient controls are employed so the surface is roughened without removing excess material.

I. Wood Surface Preparation:
   1. Damaged wood surfaces shall be replaced or repaired in a manner acceptable to the Engineer prior to the start of surface preparation.
   2. Knots and other resinous areas shall be solvent cleaned (mineral spirits) and coated with shellac or other knot sealer, prior to painting. All pitch shall be removed by scraping and wiped clean with mineral spirits or turpentine prior to applying the knot sealer.
   3. All sharp edges shall be rounded by light sanding prior to priming.
   4. After priming, all cracks, holes, and other surface irregularities shall be filled flush with the surrounding surface and sanded smooth. The filler shall be a wood putty approved by the paint manufacturer for the paint system. For natural finishes, the color of the wood putty shall match the color of the finished wood.
   5. Fill all holes flush with a synthetic-based wood putty. Putty shall be applied before or after the prime coat, depending on compatibility and the putty manufacturer's recommendations.
   6. Cellulose type putty shall be used for stained wood surfaces.
   7. Surfaces shall be clean and dry prior to painting.

J. Dry Wall:
   1. Normally, new gypsum wallboard surfaces need no special preparation before painting. All surfaces should be dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.
   2. Joints between panels should be reinforced and carefully concealed. Fastener heads should be covered. Sand joint compound with fine grit sandpaper to produce a smooth, flat surface.

3. Water-resistant gypsum wallboard is a special grade produced for use in areas involving frequent contact with water. Latex or water-thinned paint products are not recommended for applications to this type of wallboard. Only solvent type paints and coatings should be used.

K. Preparation of Existing Coated Surfaces:

1. Existing primed surfaces to be final coated shall be detergent washed and freshwater rinsed. Loose, abraded, or damaged coatings shall be cleaned to substrate by Hand or Power Tool, SP 2 or SP 3. Surrounding intact coating shall be feathered. One spot coat of the specified primer shall be applied to bare areas overlapping the prepared existing coating. One full finish coat of the specified finish coat(s) shall be applied overall. Pre-primed ductile iron pipe will require an application of a seal coat prior to the application of a cosmetic finish coat.
2. Brushoff Blast Cleaning: The equipment, procedure, and degree of cleaning shall conform to the Steel Structures Painting Council Surface Preparation 7, Brushoff Blast Cleaning. The abrasive may be either wet or dry blasting sand, grit, or nut shell. The various surface preparation parameters such as size and hardness of the abrasive, nozzle size, air pressure, and nozzle distance from the surface shall be selected such that the surface is cleaned without pitting, chipping, or otherwise damaging the surface. The Contractor shall verify his parameter selection by blast cleaning a trial area that will not be exposed to view. The trial blast cleaned area shall be subject to the approval of the Engineer and shall be used as a representative sample of the surface preparation.

L. Acid Etching: After pre-cleaning, the following solution is spread by brush or plastic sprinkling can: 1 part commercial muriatic acid reduced by 2 parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HC1. Workmen shall be equipped with necessary protective clothing. The application rate shall be approximately 2 gallons per 100 square feet. Work the acid solution into the surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained. The acid will react vigorously for a few minutes, during which time brushing is continued. After the bubbling has subsided (10 minutes), hose down the remaining slurry with high pressure clean water. Rinsing must be done immediately to avoid formation of salts on the surface that are difficult to remove. Thorough rinsing is necessary to remove any residual acid surface condition that can impair adhesion. The surface shall be completely dry before coating is applied. After etching, the surface shall be "grainy" to the touch. If not, repeat the treatment.

M. Solvent Cleaning: Solvent cleaning shall consist of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by the use of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action. This method conforms to Steel Structures Painting Council SP 1.

N. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high-pressure water. Remove oxidation with acid etch and solvent washing. Apply wash primer immediately following cleaning.

O. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.

P. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of wash primer.

3.6 PROTECTION

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Openings in motors shall be masked to prevent paint and other materials from entering the motors.

B. Repair damage to other surfaces caused by work of this Section.

C. Provide drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

3.7 APPLICATION

A. General:
1. Apply products in accordance with manufacturer's instructions.
2. Do not apply finishes to surfaces that are not dry.
3. Apply each coat to uniform finish.
4. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
5. Comply with the manufacturer’s directions regarding re-coat time frames.
6. Allow applied coat to dry before next coat is applied.

B. Multiple-component coatings shall be prepared using all of the contents of the container for each component as packaged by the paint manufacturer. No partial batches will be permitted. Multiple-component coatings that have been mixed shall not be used beyond their pot life. The Contractor shall provide small quantity kits for touch up painting and for painting other small areas. Only the components specified and furnished by the paint manufacturer shall be mixed. No intermixing of additional components for reasons of color or otherwise, even within the same generic type of coating, will be permitted.

C. Shop Primed or Factory Finished Surfaces: All shop primed or factory finished items shall be inspected at the jobsite for compliance with these Specifications. Schedule such inspection with the Engineer in advance. Abraded areas on factory-finished items shall be repaired in strict accordance with the equipment manufacturer's directions. Repaired areas shall be carefully blended into the original finish.

D. Film Thickness:
1. Coverage is listed as either total minimum dry film thickness in mils (MDFT) or the spreading rate in square feet per gallon (SFPG). Per coat determinations are listed as MDFTPC or SFPGPC. The number of coats is the minimum required irrespective of the coating thickness. Additional coats may be required to obtain the minimum required paint thickness, depending on method of applications, differences in manufacturer's products, and atmospheric conditions. Maximum film build per coat shall not exceed the coating manufacturer's recommendations.

2. Film thickness measurements and electrical inspection of the coated surfaces shall be performed with properly calibrated instruments. Recoat and repair as necessary for compliance with the Specifications. All coats will be subject to inspection by the Engineer and the coating manufacturer's representative.
3. Concrete, nonferrous metal, plastic, and wood surfaces shall be visually inspected to ensure proper and complete coverage has been attained.
4. Particular attention shall be given edges, angles, flanges, etc. Where insufficient film thicknesses are likely to be present, ensure proper millage in these areas.

E. Porous Surfaces: Porous surfaces such as concrete, masonry, etc., may have the prime coat thinned to provide maximum penetration and adhesion. Type and amount of thinning shall be determined by the paint manufacturer and is dependent upon the surface density and type of coating.

F. Damaged Coatings:
1. Damaged coatings, pinholes, and holidays shall have the edges feathered and repaired in accordance with the recommendation of the paint manufacturer, as reviewed by the Engineer.
2. All finish coats, including touch up and damage-repair coats shall be applied in a manner that will present a uniform texture an color-matched.

G. Unsatisfactory Application:
1. If the item has an improper finish color, or insufficient film thickness, the surface shall be cleaned and top coated with the specified paint material to obtain the specified color and coverage. Specific surface preparation information to be secured from the coating manufacturer and the Engineer.
2. All visible areas of chipped, peeled, or abraded paint shall be hand or power sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required by the Engineer.
3. Work shall be free of runs, bridges, shiners, laps, or other imperfections. Evidence of these conditions shall be cause for rejection.
4. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer.
5. Leave all staging up until the Engineer has inspected the surface or coating. Staging removed before approval by Engineer shall be replaced.

3.8 CLEANING

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.

B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Collect cotton waste, cloths, empty paint containers, and material that may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.9 PROTECTIVE COATINGS SYSTEMS

System No.	Title
1	Submerged Metal - Potable Water
2	Submerged Metal - Sewage
5	Exposed Metal - Mildly Corrosive
6	Exposed Metal - Atmospheric
8	Buried Metal - General
10	Galvanized Metal Conditioning
11	Galvanized Metal Repair
17	Special Coating – Concrete
20	Immersion Service – Concrete
22	Chemical-Resistant Wall – Concrete
23	Chemical-Resistant Wall - Concrete Masonry
26	Canvas Jacketed Pipe
27	Aluminum and Dissimilar Metal Insulation

A. System No. 1, Submerged Metal - Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 5)	Polyamide, Anti-Corrosive, Epoxy Primer, Potable Water Service	1 coat, 5 MDFT
	Polyamide Epoxy, High Solids, Potable Water Service	1 coat, 5 MDFT

B. System No. 2, Submerged Metal - Sewage:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 5)	Polyamide Epoxy, High Solids	2 coats, 14 MDFT

C. System No. 5, Exposed Metal - Mildly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10) or Surface Prep. for System No. 10 for Galvanized or Copper Surface	Polyamide, Anti-Corrosive Epoxy Primer or System No. 10 for Galvanized or Copper Surfaces	1 coat, 3 MDFT
	Polyamide High Build Epoxy	1 coat, 5 MDFT

D. System No. 6, Exposed Metal - Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6)	Rust-Inhibitive Primer or System No. 10 for Galvanized or Copper Surfaces	1 coat, 3 MDFT
	Polyamide High Build Epoxy	1 coat, 5 MDFT
	Polyurethane	1 coat, 2 MDFT

E. System No. 8, Buried Metal - General:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Polyamide Epoxy, High Solids	2 coat, 14 MDFT

F. System No. 10, Galvanized Metal Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP1)	Wash Primer	1 coat, 0.4 MDFT
Followed by Hand Tool (SP 2) or Power Tool (SP 3)	Finish Coats: See System Nos. 5 and 6	

G. System No. 11, Galvanized Metal Repair:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1) Followed by Hand Tool (SP 2), Power Tool (SP 3), or Brushoff Blast (SP 7)	Organic Zinc Rich Primer	1 coat, 3 MDFT

H. System No. 17, Special Coating - Concrete:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Epoxy Floor Primer	1 coat, 10 MDFT
	Epoxy Floor Finish	2 coats, 10 MDFTPC

I. System No. 20, Immersion Service - Concrete:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Polyamide Epoxy High Solids	1 coat, 3 MDFT
	Polyamide Epoxy High Solids	1 coat, 8 MDFT

J. System No. 22, Chemical-Resistant Wall - Concrete:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Epoxy Block Filler	1 coat, As required to Fill Voids
	Polyamide Epoxy High Build	1 coat, 300 SFPG
	Polyamide Epoxy High Build, Gloss	1 coat, 160 SFPG

K. System No. 23, Chemical-Resistant Wall - Concrete Masonry:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete Masonry	Epoxy Block Filler	1 coat, As Required to Fill Voids
	Polyamide Epoxy High Build	1 coat, 300 SFPG
	Polyamide Epoxy High Build, Gloss	1 coat, 160 SFPG

L. System No. 26, Canvas Jacketed Pipe Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Remove All Oil and Grease	Canvas Sealer	1 coat, 200 SFPG
	Acrylic Latex	2 coats, 240 SFPGPC

M. System No. 27, Aluminum and Dissimilar Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP1)	Wash Primer	1 coat, 0.4 MDFT
	Polyamide Epoxy, High Solids	1 coat, 10 MDFT

3.10 ARCHITECTURAL PAINT SYSTEMS

System No.	Title
105	Wood, Stained and Varnished (Interior)
107	Metal Trim and Structural Steel
109	Concrete Masonry, Gloss
110	Concrete Masonry, Exterior
113	Concrete, Gloss
115	Gypsum Wallboard & Plaster, Gloss
120	Exterior Concrete Tank Coating
125	Exterior Masonry Water Repellent Coating

A. System No. 105, Wood, Stained and Varnished (Interior or Exterior):

Surface Prep.	Paint Material	Min. Coats, Cover
Wood	Interior Stain	Match Sample
	Sanding Sealer	1 coat, 450 SFPG
	Varnish Interior – Polyurethane satin Exterior – Alkyd gloss	2 coats, 450 SFPGPC

B. System No. 107, Metal Trim and Structural Steel

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6)	Rust-Inhibitive Primer	1 coat, 2 MDFT
Pickle (SP 8)	Alkyd Enamel (Semi-Gloss)	2 coats, 4 MDFT

C. System No. 109, Concrete Masonry, Gloss:

Surface Prep.	Paint Material	Min. Coats, Cover
Masonry	Epoxy Block Filler	1 coat, as required to fill voids
	Waterborne Epoxy Acrylic (Gloss)	1 coat, 3 MDFT

D. System No. 110, Concrete Masonry, Exterior:

Surface Prep.	Paint Material	Min. Coats, Cover
Masonry	Acrylic Bock Filler	1 coat, 75 SFPG
	Acrylic Latex (Flat)	2 coats, 240 SFPGPC

E. System No. 113, Concrete, Gloss:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Waterborne Epoxy Acrylic (Gloss)	2 coats, 5 MDFT

F. System No. 115, Gypsum Wallboard and Plaster, Gloss:

Surface Prep.	Paint Material	Min. Coats, Cover
Dry Wall	Alkyd Primer/Sealer	1 coat, 350 SFPG
	Waterborne Epoxy Acrylic (Gloss)	1 coat, 3 MDFT

G. System No. 120, Exterior Concrete Tank Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	High Solids Water Borne Coating	2 coats, 300 SFPGPC

H. System No. 125, Exterior Masonry Water Repellent Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Silane-Based Water Repellent Coating	1 coat, 150 SFPGPC

3.11 PAINT APPLICATION SCHEDULE

A. Unless otherwise indicated in the Specifications or on the Drawings, the work shall be painted or coated in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from the Engineer before starting the work in question.

B. System No. 1, Submerged Metal - Potable Water: This system shall be used on the following items or areas:
   a. Not Used.

C. System No. 2, Submerged Metal - Sewage: This system shall be used on the following items or areas:
   1. All metal surfaces below a plane 1 foot above the maximum liquid surface, all metal surfaces above the maximum liquid surface that are a part of the immersed equipment, all concrete embedded surfaces of metallic items under submerged conditions, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, except, reinforcing steel; and all metallic items in manholes and wetwells.

D. System No. 5, Exposed Metal - Mildly Corrosive: This system shall be used on the following items or areas:
   1. Exposed metal surfaces located inside of structures and enclosures, and the following specific surfaces shall receive this system:
      a. All new equipment and motors inside of structures.

b. Exposed new and modified metallic non-stainless steel and plastic piping, valves, and all unfinished miscellaneous metal associated with the piping inside structures.
c. All exposed structural steel columns, roof supports, and all other exposed steel members; exposed steel hardware for glue-lam system.
d. Underside of exposed roof deck if specified on Interior Finish Schedule.

E. System No. 6, Exposed Metal - Atmospheric: This system shall be used on the following items or areas:
1. Exposed metal surfaces located outside of enclosed structures and exposed to weather, including metal doors and frames, vents, louvers, flashings, sheet metalwork, lintels, and miscellaneous architectural metal trim, guard posts, hydrants, and the following specific surfaces shall receive this system:
a. Exposed new and modified non-stainless steel metal piping, valves, and all unfinished miscellaneous metal associated with the piping outside enclosed structures and exposed to weather.
b. All new equipment and motors outside of enclosed structures.

F. System No. 8, Buried Metal - General: This system shall be used on the following items or areas:
1. All buried, below grade portions of steel items, except buried stainless steel or ductile iron.

G. System No. 10, Galvanized Metal Conditioning: This system shall be used on the following items or areas:
1. All galvanized surfaces requiring painting and the following specific surfaces shall receive this system:
a. As primer for all galvanized and copper surfaces scheduled to receive System Nos. 5 and 6.
b. Underside of exposed metal roof decking.

H. System No. 11, Galvanized Metal Repair: This system shall be used on the following items or areas:
1. All galvanized surfaces that are abraded, chipped, or otherwise damaged.

I. System No. 17, Special Coating - Concrete: This system shall be used on the following items or areas:
1. All floors and surfaces designated on the Interior Finish Schedule.

J. System No. 20, Immersion Service - Concrete: This system shall be used on the following items or areas:
1. The walls and ceiling of the raw sewage wet well.

K. System No. 22, Chemical-Resistant Wall - Concrete: This system shall be used on the following items or areas:
1. Not Used.

L. System No. 23, Chemical-Resistant Wall - Concrete Masonry: This system shall be used on the following items or areas:
1. Not Used.

M. System No. 26, Canvas Jacketed Pipe: This system shall be used on the following items or areas:
   1. Outside surfaces of all exposed canvas jacketed insulated piping.

N. System No. 27, Aluminum and Dissimilar Metal Insulation: This system shall be used on all nonsubmerged concrete embedded aluminum surfaces, all contacts between dissimilar metals, and all aluminum surfaces in contact with concrete or masonry.

O. System No. 105, Wood, Stained and Varnished: This system shall be used on the following items or areas:
   1. All interior and exterior wood surfaces.
   2. All exposed glue-lam wood surfaces – one finish coat of varnish after erection.

P. System No. 107, Metal Trim and Structural Steel: This system shall be used on the following items or areas:
   1. Interior metal doors and frames (Unless noted otherwise on Interior Finish Schedule), and miscellaneous metal trim exposed to view.
   2. Overhead cranes and monorails.
   3. Note: Structural steel and glue-lam fasteners are covered under System No. 5.

Q. System No. 109, Concrete Masonry, Gloss: This system shall be used on the following items or areas:
   1. All interior concrete masonry unit walls as indicated in the Interior Finish Schedule.

R. System No. 110, Concrete Masonry, Exterior: This system shall be used on the following items or areas:
   1. Not Used.

S. System No. 113, Concrete, Gloss: This system shall be used on the following items or areas:
   1. Interior concrete walls and ceilings as indicated in the Interior Finish Schedule.

T. System No. 115, Gypsum Wallboard and Plaster, Gloss: This system shall be used on the following items or areas:
   1. All interior gypsum board as indicated in the Interior Finish Schedule.

U. System No. 120, Exterior Concrete Tank Coating: This system shall be used on the following items or areas:
   1. Not used.

V. System No. 125, Exterior Masonry Water Repellent Coating: This system shall be used on the following items or areas:
   1. All exposed brick and concrete masonry surfaces.

(See PSDS form following this section)

END OF SECTION

PAINT SYSTEM DATA SHEET

Attached products' Technical Data Sheet (if applicable) to this sheet for each paint system submittal.

Paint System Number (from spec.) _____

Paint System Title (from spec.) _____

Coatings Supplier _____

Representative _____

Surface Preparation _____

Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats Coverage

SECTION 10441

SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Painted aluminum, exterior.
   2. Painted aluminum, interior.
   3. Cast aluminum letters.
   4. Engraved plastic.

1.2 PERFORMANCE REQUIREMENTS

A. Exterior signs shall be designed to withstand a wind loading of 30 psf without damage or permanent deflection.

B. Exterior Signs, Post and Concrete Anchorage: In strict accordance with latest edition of Manual on Uniform Traffic control Devices for Streets and Highways, U.S. Department of Transportation, Federal Highway Administration.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Division 1.

B. Submit shop drawings listing sign styles, lettering and locations, and overall dimensions of each engraved sign.

C. Submit samples under provisions of Division 1.

D. Submit two samples illustrating full size sample sign, of type, style and color specified including method of attachment.

E. Submit manufacturer's installation instructions under provisions of Division 1.

F. Include installation template and hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Package signs, labeled in name groups.

B. Store adhesive tape at ambient room temperatures.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install interior plastic signs when ambient temperature is below 70 degrees F. Maintain this minimum during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Seton (www.seton.com).

B. Best (www.bestsigns.com).

C. Kaltech (www.Kaltech.com).

D. Champion America (www.champion-america.com).

E. Approved equal.

2.2 SIGNAGE TYPES:

A. The following sign types shall be provided as shown on the Drawings and signage schedule:

Type 1

Wall and Post Mounted Traffic Signs: Painted aluminum reflectorized signs, conforming to U.S. Department of Transportation Manual on Uniform Traffic Control Devices for Streets and Highways, ANSI D6.1. Materials and fabrication shall conform to State of Wisconsin Standards. Provide steel U-channel posts in green enamel finish for traffic signs in lengths required.

Type 2

Wall Mounted Sign: 20-inches wide x 14-inches minimum high, square corner, .063 inches thick aluminum with baked enamel finish. Use includes Safety Signage, conforming to OSHA requirements.

Type 3

Wall Mounted Building Signs: Exterior non-illuminated, individual aluminum letters, upper case Helvetica medium, 8-inch high letters, natural satin finish, text as indicated on drawings. Provide spacer mounting as recommended by sign manufacturer.

Type 4

Wall Mounted Room Signs: Interior engraved plastic. 12 inches wide by 3 inches high, typical, plus standard ADA toilet room signs. Adhesive attached. Do not include any number suffixes as indicated in the Room Finish Schedule into the sign text. Example: All storage rooms shall have signs that only read “STORAGE”, not “STORAGE 1”, “STORAGE 2”, etc.

2.3 LETTERING

A. Style: Upper case Helvetica, medium, unless indicated otherwise.

2.4 ACCESSORIES

A. Mounting Hardware: Stainless steel anchors.

B. Tape Adhesive: Double sided tape, permanent adhesive.

2.5 FINISHES

A. As stated under Types above, colors to be selected from manufacturer's standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means installer accepts existing surfaces.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install signs after surfaces are finished, in locations scheduled.

C. Install Type 2 Signs with double-faced tape at 5-foot 6-inches above floor on doors or walls. Center signs on doors.

D. Clean and polish.

3.3 SCHEDULES

Sign Type	Purpose	Location	Quantity
1.	-	-	-
2.	Wetwell Warning*	Pump Room; Exterior	2
	Vacuum Warning*	Pump Room	1
	Danger High Voltage	Generator Room	1
3.	-	-	-
4.	-	-	-

*Text to be determined during submittal review.

END OF SECTION

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SECTION 10523

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fire extinguishers and brackets for wall mounting.

1.2 REFERENCES

A. National Fire Protection Association:
   1. NFPA 10 - Standard for Portable Fire Extinguishers.

B. Underwriters Laboratories Inc.:
   1. UL - Fire Protection Equipment Directory.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

1.4 SUBMITTALS

A. Submit product data under the provisions of Division 1.

B. Product Data: Submit extinguisher operational features, color and finish, and anchorage details.

C. Manufacturer's Installation Instructions.

1.5 CLOSEOUT SUBMITTALS

A. Submit manufacturer’s operation and maintenance data under the provisions of Division 1.

B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.

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PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Manufacturers:
   1. JL Industries
   2. Larsen's Manufacturing Co.
   3. Nystrom Products Co.
   4. Potter Roemer
   5. Substitutions: Under the provisions of Division 1.

B. Multi-purpose Dry Chemical Type: Cast steel tank, with pressure gage; minimum UL rating 4A-60B:C, 10-pound capacity.

C. Extinguisher Finish: Steel, enamel, red color.

2.2 ACCESSORIES

A. Extinguisher Brackets for wall mounting: Heavy Duty steel, manufacturer's standard red finish, with bottom support and clip-together chrome strap.

PART 3 EXECUTION

3.1 EXAMINATION

A. Coordination and project conditions: Under the provisions of Division 1.

3.2 INSTALLATION

A. Install wall brackets, maximum 48 inches from finished floor to top of extinguisher handle.

B. Secure rigidly in place.

C. Place extinguishers on wall brackets.

D. Distribute the scheduled quantity of extinguishers as directed by the owner and in accordance with NFPA 10.

E. See locations on drawings.

END OF SECTION

PROJECT MANUAL
FOR THE CONSTRUCTION OF

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS

SOUTH MILWAUKEE, WISCONSIN

VOLUME 2

Applied Technologies
Engineers - Architects

APRIL 2018

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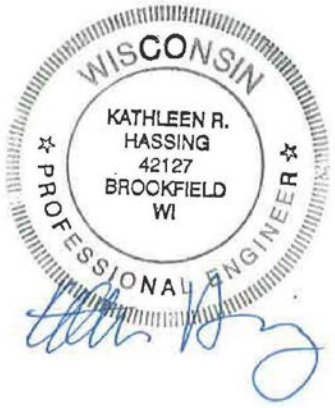

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SOUTH MILWAUKEE, WISCONSIN

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SECTION 11316

SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

A. Submersible Pumps:
   1. Lift Station Pump No. 1: P-1-1.
   2. Lift Station Pump No. 2: P-1-2.
   3. Lift Station Pump No. 3: P-1-3.
   4. Lift Station Pump No. 4: P-1-4.

B. Major components included, but not limited to:
   1. Pump and motor.
   2. Mounting system.
   3. Mix flush valve.
   4. Instrumentation and control.
   5. Spare parts.

1.2 SYSTEM DESCRIPTION

A. The pumps will pump residential and commercial wastewater from a collection system lift station.

1.3 REFERENCES

A. Hydraulic Institute Standards.
   1. ASTM A 108 - C41 - Specification for Steel, Carbon, Cold-Rolled Standard Quality.
   2. ASTM A 48 - Gray Iron Castings.
   3. AFBMA Std. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   4. AFMBA Std. 11 - Load Ratings and Fatigue Life for Roller Bearings.

1.4 DESIGN REQUIREMENTS

A. General Requirements:
   1. Liquid pumped: Raw Sewage.
   2. Pump Installation: Submersible.
   3. Specific gravity of liquid: 1.0.
   4. Maximum liquid temperature (F): 100.
   5. Percent solids (%): <0.5.
   6. Discharge size (inch):
      a. Pump No. 1: 8-inch.
      b. Pump Nos. 2 – 4: 10-inch
   7. Solids Handling: Minimum 3-inch compressible solids.

B. Hydraulic Requirements:

1. Pump No. 1:
    a. Primary Design Condition (one pump operating):
        1) Flow, gpm: 1,600.
        2) TDH, feet: 45.8.
    b. Secondary Design Condition (three pumps operating, total flow of 8,400 gpm):
        1) Flow, gpm: 1,600
        2) TDH, feet: 62.2
    c. Minimum shutoff head, feet: 95.
2. Pump Nos. 2, 3, 4:
    a. Primary Design Condition (three pumps operating, total flow of 8,400 gpm):
        1) Flow, gpm: 3,400.
        2) TDH, feet: 63.6.
    b. Minimum shutoff head, feet: 135.

1.5 SUBMITTALS

A. Include all submersible pumps in a single submittal package. Partial or incomplete submittals will not be reviewed.

B. Shop drawings: Submit under provisions of Division 1, including the following:
1. Pump data and dimensions.
2. Impeller type.
3. Motor data.
4. Complete performance curves showing:
    a. Capacity.
    b. Head.
    c. Horsepower.
    d. Efficiency.

C. Submit operations and maintenance manual under the provisions of Division 1.

D. Submit certificates of proper installation and operator training under provisions of Division 1.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle the equipment under the provisions of Division 1.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Xylem – Flygt, Pewaukee, WI.

2.2 GENERAL

A. All equipment shall be the end product of one pump system manufacturer. The manufacturer shall be responsible for the complete system including all items covered herein.

2.3 METAL FABRICATION

A. Furnish metal parts described herein conforming details in the Drawings.

B. Anchor bolts, fasteners, nuts, and washers: 316 stainless steel.

2.4 EQUIPMENT

A. Motors:
   1. Motor nameplate horsepower:
      a. Pump No. 1: 45 HP.
      b. Pump Nos. 2, 3, 4: 85 HP.
   2. Drive type: Adjustable Speed.
   3. Motor shall be inverter duty rated and meet NEMA MG1, Part 31.
   4. Power: 460 VAC, three phase, 60 Hz.
   5. Continuous duty, 30 starts per hour.
   6. Enclosure: Submersible.
   7. Rating: Class 1, Div. 1, Groups C & D.
   8. Service Factor: 1.15.
   9. Efficiency, minimum: 90%.
   10. The motor shall not be overloaded beyond the nameplate rating under any normal conditions encountered, throughout the entire pump performance range.
   11. Provide temperature sensors embedded in motor windings.
   12. Motor shaft: AISI Type 431 Stainless Steel.
   13. Insulation: Moisture resistant, Class H.

B. Electrical Power and Signal Cable:
   1. Type: Water proof.
   2. Power cord entry to pump: Protected with a compression fitting consisting of a single cylindrical elastomer grommet flanged with washers to provide ease of changing the cable.
   3. Length (each): 50 feet.

C. Pump Construction:
   1. Pump volute, motor and seal housings:
      a. Construction: Close-grained cast iron ASTM A 48 Class 35B.
      b. Seals: External mating parts machined and fitted with Nitrile or Viton rubber O-rings.
      c. Exposed fasteners: AISI Type 316 stainless steel.
   2. Shaft:
      a. The pump shaft shall be an extension of the motor shaft.
      b. Construction: AISI Type 431 Stainless Steel.
   3. Shaft bearings:

a. Provide an upper and lower set of bearings that compensate for axial thrust and radial forces, AFBMA 9 and AFBMA 11.
b. Bearing life: B-10 life of 50,000 hours AFBMA 9 and AFMBA 11
c. Lubrication: Permanently grease lubricated.

4. Mechanical seal:
   a. Number of seals: Two.
   b. Type: Mechanical with tungsten carbide versus tungsten carbide seal faces for the lower primary seal, and tungsten carbide versus tungsten carbide for the upper secondary seal faces.
   c. Mounting: Tandem with an oil chamber between seals.
   d. Lubrication: Oil bath.
5. Impeller:
   a. Construction: ASTM A532 (Alloy IIIA) 25% chrome cast iron RC 60.
   b. Impeller type: Semi-open, multi-vane backswept design. Leading vane edges hardened to RC 60.
   c. Balancing: Dynamically balanced.

D. Base Elbows and Mounting System:
1. Discharge elbow:
   a. Provide vertical discharge.
   b. Construction: Closed-grained cast iron ASTM A48 CL30.
   c. Include guide rail lower mounting fitting.
2. Guide rails:
   a. Number of guide rails per pump: 2.
   b. Length, feet: See Drawings.
   c. Construction: 3-inch, 316 stainless steel.
   d. Provide a 40 foot stainless steel lifting cable for each pump. Provide stainless steel cable holders.
3. Include upper and intermediate guide rail supports for each pump.

2.5 ACCESSORIES

A. Mix Flush Valve:
1. Provide Flygt Mix-Flush Valves, or approved equal, for Pump No. 1 and Pump No. 4. Valves shall be mounted directly on the pump volutes.
2. Valve shall be positioned so as to provide non-clogging operation and discharge greater part of pumped volume into sump to flush solids into suspension at each pumping cycle.
3. Valve shall be open at start of each pump cycle and close under full pump discharge pressure. Valve open time shall be adjustable.
4. Valve shall operate by liquid being pumped and through a self-contained hydraulic system. An external power source shall not be required to operate valve.

2.6 FINISHING

A. Shop and Field Painting: Acrylic dispersion zinc phosphate primer with a polyester resin paint finish. Minimum finish thickness of 6 mils.

2.7 INSTRUMENTATION AND CONTROL

A. Pump Control Sensors:
   1. Moisture Detectors:
      a. Provide in motor stator chamber.
      b. Upon the moisture sensors sensing moisture in the stator chamber, the controls shall shut down the pump, indicate pump fail alarm, and activate the remote common fail.
   2. Temperature Sensors:
      a. Provide thermal switches for each phase in pump motor.
      b. Upon the temperature sensors sensing a high temperature in the motor stator, the controls shall shut down the pump, indicate pump fail alarm, and actuate the remote common fail. Automatically reset when temperature returns to normal.
   3. Provide Flygt Mini CAS Relay: Provide with each pump to be mounted in respective Power Panel or Local Control Panel as shown on drawings

PART 3 EXECUTION

3.1 INSTALLATION

A. Install pumps in accordance with the Drawings, shop drawings and manufacturer's instructions.

B. Level bases and grout with non-shrinking grout.

3.2 MANUFACTURER'S SERVICES

A. Provide manufacturer's services under provisions of Section 01445.

B. Minimum Service Requirements:
   1. Installation: As required for proper installation.
   2. Start-up and Field Testing: One half day on site.
   3. Operating Training: One half day on site.

C. Service to Repair Defective Work: Provide during one-year warranty period under the provisions of the General Conditions.

END OF SECTION

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SECTION 11338

MOTORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single phase electric motors.

B. Three phase electric motors.

1.2 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

D. ANSI/NEMA MG 1 - Motors and Generators.

E. ANSI/NFPA 70 - National Electrical Code.

F. EISA – Energy Independence and Security Act of 2007.

1.3 SUBMITTALS

A. Submit product data under provisions of Division 1.

B. Submit test results verifying nominal efficiency and power factor for three phase motors larger than 5 horsepower.

C. Submit manufacturer's installation instructions under provisions of Division 1.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of electric motors for General use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

1.6 REGULATORY REQUIREMENTS

A. ANSI/NFPA MG 1.

B. EISA.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 1.

B. Store and protect products under provisions of Division 1.

C. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.8 WARRANTY

A. Provide manufacturer's warranty under provisions of Division 1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Marathon.

B. U.S. Motors.

C. Westinghouse/TECO

D. General Electric.

E. Or Equal.

F. Substitutions: Under provisions of Division 1.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service: Refer to Division 16 for required electrical characteristics.

B. Motors: Design for continuous operation in 40 degrees C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor, and motor enclosure type.

C. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.

D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency.

E. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide [screwed] conduit connection in end frame.

2.3 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated ball bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.6 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between one and one and one-half times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Conform to ANSI/NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data.

G. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Thermostat System (for all motors operated by VFD): Three thermostats imbedded in motor windings and epoxy encapsulated. Series connected with wires brought to a motor terminal box. This terminal box shall be a separate box; not shared with the motor's power terminal box.

I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J. Sound Power Levels: To ANSI/NEMA MG 1.

K. Weatherproof Epoxy Sealed Motors (Where Indicated): Epoxy coat windings with rotor and starter surfaces protected with epoxy enamel. Bearings shall be double shielded with waterproof non-washing grease.

L. Nominal Efficiency: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112. Motors manufactured January 2011 or later shall conform to EISA (Premium Efficiency Levels) listed in paragraphs 3.12 and 3.13.

M. Nominal Power Factor: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

PART 3 EXECUTION

3.1 APPLICATION

A. Motors drawing less than 250 Watts and intended for intermittent service may be germaine to equipment manufacturer and need not conform to these specifications.

B. Motors shall be open drip-proof (ODP) for non-process applications, except where specifically noted otherwise. Motors on process equipment specified in Division 11 shall be totally-enclosed fan cooled (TEFC), except where specifically noted otherwise.

C. Motors with frame sizes 254T and larger shall be energy efficient type.

D. Single phase motors for shaft mounted fans shall be split phase type.

E. Single phase motors for shaft mounted fans or blowers shall be permanent split capacitor type.

F. Single phase motors for fans shall be capacitor start type.

G. Motors located in exterior locations shall be weatherproof epoxy-treated type.

3.2 NEMA OPEN MOTOR SERVICE FACTORS

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6 - 1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5 - 150	1.15	1.15	1.15	1.15

3.3 PERFORMANCE SCHEDULE: SINGLE PHASE – OPEN, DRIP-PROOF

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1-1/2	1200	67	60
2	1200	68	65
3	1200	75	80
1/8	1800		
1/6	1800	49	58

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/4	1800		52
1/3	1800	56	55
1/2	1800	64	65
3/4	1800	63	64
1	1800	68	72
1-1/2	1800	70	64
2	1800	73	72
3	1800	78	78
5	1800	74	76
7-1/2	1800	77	85
10	1800	84	90
1/3	3600	55	68
1/2	3600	57	71
3/4	3600	62	75
1	3600	63	69
1-1/2	3600	68	77
2	3600	71	75
3	3600	76	88
5	3600	76	88
7-1/2	3600	81	82
10	3600	83	86

3.4 PERFORMANCE SCHEDULE: SINGLE PHASE – TOTALLY ENCLOSED, FAN COOLED

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/6	1200	41	48
1/4	1200	44	50
1/3	1200	57	56

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/2	1200	59	63
3/4	1200	68	68
1	1200	67	67
1-1/2	1200	71	69
2	1200	82	84
3	1200	80	82
5	1200		
1/12	1800		
1/8	1800	47	55
1/6	1800	49	58
1/4	1800	53	52
1/3	1800	56	55
1/2	1800	63	67
3/4	1800	66	68
1	1800	68	72
1-1/2	1800	73	77
2	1800	75	81
3	1800	78	87
5	1800	82	87
7-1/2	1800	84	
10	1800		
1/8	3600	55	68
1/6	3600	57	
1/4	3600	66	
1/3	3600	70	
1/2	3600	57	71
3/4	3600	66	74

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1	3600	66	81
1-1/2	3600	70	82
2	3600	74	78
3	3600	76	87
5	3600	84	96
7-1/2	3600	82	89
10	3600	86	98

3.5 PERFORMANCE SCHEDULE: SINGLE PHASE – EXPLOSION PROOF

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/3	1200	54	56
½	1200	59	63
3/4	1200	65	67
1	1200	67	67
1-1/2	1200	71	69
1/3	1800	56	58
1/2	1800	65	65
3/4	1800	66	68
1	1800	66	67
1-1/2	1800	70	70
2	1800	75	81
3	1800	79	77
5	1800	74	81
1/2	3600	55	69
3/4	3600	62	75
1	3600	66	81
1-1/2	3600	70	82

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
2	3600	74	82
3	3600	76	87

3.6 PERFORMANCE SCHEDULE: THREE PHASE – OPEN, DRIP-PROOF
(applies to U-frame, close-coupled pumps, footless, and vertical-shaft motors only)

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/2	900	71	57
3/4	900	74	56
1	900	71	66
1-1/2	900	74	67
2	900	73	63
3	900	76	60
5	900	80	60
7-1/2	900	85	62
1/4	1200		
1/3	1200		
1/2	1200	71	58
3/4	1200	77	67
1	1200	77	69
1-1/2	1200	78	77
2	1200	78	72
3	1200	79	72
5	1200	83	76
7-1/2	1200	85	78
10	1200	86	78
15	1200	87	82
20	1200	87	81

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
25	1200	88	84
30	1200	88	80
40	1200	89	85
50	1200	90	87
60	1200	90	82
75	1200	90	83
100	1200	91	85
125	1200	92	85
150	1200	91	84
200	1200	93	
250	1200	93	
1/4	1800		
1/3	1800		
1/2	1800	74	63
3/4	1800	74	60
1	1800	75	64
1-1/2	1800	79	69
2	1800	80	70
3	1800	81	77
5	1800	84	82
7-1/2	1800	86	76
10	1800	87	78
15	1800	87	77
20	1800	89	86
25	1800	89	83
30	1800	90	86
40	1800	91	85

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
50	1800	91	85
60	1800	90	83
75	1800	90	86
100	1800	91	86
125	1800	92	86
150	1800	92	88
200	1800	92	89
250	1800	92	90
1/3	3600		
1/2	3600	74	63
3/4	3600	75	73
1/2	3600	67	63
1	3600	75	64
1-1/2	3600	78	82
2	3600	80	86
3	3600	81	84
5	3600	81	88
7-1/2	3600	84	85
10	3600	87	89
15	3600	87	91
20	3600	89	86
25	3600	89	87
30	3600	87	87
40	3600	90	87
50	3600	88	89
60	3600	90	88
75	3600	90	84

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
100	3600	93	83
125	3600	89	88
150	3600	90	89
200	3600	91	89
250	3600	92	90

3.7 PERFORMANCE SCHEDULE: THREE PHASE – EXPLOSION PROOF

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/3	1200		
1/2	1200	71	58
3/4	1200	72	70
1	1200	82.5	69
1-1/2	1200	87.5	77
2	1200	88.5	68
3	1200	89.5	75
5	1200	89.5	
7-1/2	1200	91	
10	1200	91	
15	1200	91.7	
1/3	1800		
1/2	1800	74	60
3/4	1800	76	69
1	1800	85.5	74
1-1/2	1800	86.5	80
2	1800	86.5	80
3	1800	89.5	75
5	1800	89.5	80

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
7-1/2	1800	91.7	82
10	1800	91.5	82
15	1800	92.4	82
20	1800	93	84
25	1800	93.6	86
30	1800	93.6	87
40	1800	94.1	88
50	1800	94.5	86
60	1800	95	
75	1800	95.4	
100	1800	95.4	
1/2	3600	68	77
3/4	3600	72	79
1	3600	77	79
1-1/2	3600	84	80
2	3600	85.5	89
3	3600	86.5	87
5	3600	88.5	94
7-1/2	3600	89.5	90
10	3600	90.2	92
15	3600	91	85
20	3600	91	
25	3600	91.7	
30	3600	91.7	
40	3600	92.4	
50	3600	93	

3.8 PERFORMANCE SCHEDULE: THREE PHASE – TWO SPEED, ONE WINDING, OPEN, DRIP-PROOF, VARIABLE TORQUE

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/ 0.25	1800/ 900	80/ 86	75/ 49
1.5/ 0.37	1800/ 900	77/ 61	81/ 58
2/ 0.5	1800/ 900	77/ 60	85/ 67
3/ 0.75	1800/ 900	81/ 71	83/ 60
5/ 1.2	1800/ 900	81/ 61	84/ 65
7.5/ 1.9	1800/ 900	83/ 75	82/ 65
10/ 2.5	1800/ 900	83/ 76	87/ 66
15/ 3.7	1800/ 900		
20/ 5	1800/ 900		
25/ 6.3	1800/ 900		

3.9 PERFORMANCE SCHEDULE: THEEE PHASE – TWO SPEED, ONE WINDING, TOTALLY ENCLOSED, FAN COOLED, CONSTANT TORQUE

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/ 0.5	1800/ 900	77/ 59	80/ 48
1.5/ 0.75	1800/ 900	76/ 61	85/ 50
2/ 1	1800/ 900	75/ 64	86/ 52

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
3/ 1.5	1800/ 900	80/ 66	85/ 48
5/ 2.5	1800/ 900	83/ 69	82/ 48
7.5/ 3.75	1800/ 900		
10/ 5	1800/ 900		
15/ 7.5	1800/ 900		
25/ 13	1800/ 900		
25/ 6.3	1800/ 900		

3.10 PERFORMANCE SCHEDULE: THREE PHASE – TWO SPEED, TWO WINDING, OPEN, DRIP-PROOF, CONSTANT TORQUE

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1/ 0.44	1800/ 900	77/ 59	80/ 48
1.5/ 0.7	1800/ 900	76/ 61	85/ 50
2/ 0.9	1800/ 900	75/ 64	86/ 52
3/ 1.3	1800/ 900	80/ 66	85/ 48
5/ 2.2	1800/ 900	83/ 69	82/ 48
7.5/ 3.3	1800/ 900		
10/ 4.4	1800/ 900		

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
15/ 6.7	1800/ 900		
20/ 8.9	1800/ 900		
25/ 8.9	1800/ 900		
25/ 11	1800/ 900		

3.11 PERFORMANCE SCHEDULE: THREE PHASE – PREMIUM EFFICIENCY, OPEN, DRIP-PROOF

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1	1200	82.5	72
1-1/2	1200	86.5	73
2	1200	87.5	75
3	1200	88.5	60
5	1200	89.5	65
7-1/2	1200	90.2	73
10	1200	91.7	74
15	1200	91.7	77
20	1200	92.4	78
25	1200	93.0	74
30	1200	93.6	78
40	1200	94.1	77
50	1200	94.1	79
60	1200	94.5	82
75	1200	94.5	80
100	1200	95.0	80

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
125	1200	95.0	84
1	1800	85.5	84
1-1/2	1800	86.5	85
2	1800	86.5	85
3	1800	89.5	86
5	1800	89.5	87
7-1/2	1800	91.0	86
10	1800	91.7	85
15	1800	93.0	85
20	1800	93.0	86
25	1800	93.6	85
30	1800	94.1	88
40	1800	94.1	83
50	1800	94.5	85
60	1800	95.0	88
75	1800	95.0	88
100	1800	95.4	83
125	1800	93.0	86
150	1800	93.0	85
200	1800	95.0	85
1-1/2	3600	84.0	85
2	3600	85.5	87
3	3600	85.5	85
5	3600	86.5	86
7-1/2	3600	88.5	88
10	3600	89.5	86
15	3600	90.2	89

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
20	3600	91.0	89
25	3600	91.7	92
30	3600	91.7	91
40	3600	92.4	92
50	3600	93	89
60	3600	93.6	91
75	3600	93.6	88
100	3600	93.6	88
150	3600	94.1	88
200	3600	95.0	88

3.12 PERFORMANCE SCHEDULE: THREE PHASE – PREMIUM EFFICIENCY, TOTALLY ENCLOSED, FAN COOLED

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
1	1200	82.5	72
1-1/2	1200	87.5	65
2	1200	88.5	68
3	1200	89.5	63
5	1200	89.5	66
7-1/2	1200	91.0	68
10	1200	91.0	75
15	1200	91.7	72
20	1200	91.7	76
25	1200	93.0	71
30	1200	93.0	79
40	1200	94.1	78
50	1200	94.1	81

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
60	1200	94.5	83
75	1200	94.5	80
100	1200	95.0	83
125	1200	95.0	85
1	1800	85.5	71
1-1/2	1800	86.5	85
2	1800	86.5	85
3	1800	89.5	83
5	1800	89.5	83
7-1/2	1800	91.7	85
10	1800	91.7	84
15	1800	92.4	86
20	1800	93.0	85
25	1800	93.6	84
30	1800	93.6	86
40	1800	94.1	83
50	1800	94.5	85
60	1800	95.0	87
75	1800	95.4	87
100	1800	95.4	86
125	1800	95.4	87
150	1800	95.8	88
200	1800	96.2	87
250	1800	96.2	89
1-1/2	3600	84.0	85
2	3600	85.5	87
3	3600	86.5	87

HP	RPM (Syn)	Efficiency (%)	Power Factor (%)
5	3600	88.5	88
7-1/2	3600	89.5	86
10	3600	90.2	86
15	3600	91.0	91
20	3600	91.0	89
25	3600	91.7	92
30	3600	91.7	92
40	3600	92.4	91
50	3600	93.0	92
60	3600	93.6	93
75	3600	93.6	91
100	3600	94.1	92

END OF SECTION

SECTION 13320

GENERAL INSTRUMENTATION AND CONTROL SYSTEM

PART 1 GENERAL

1.1 WORK DESCRIPTION

A. This section covers work necessary for the hardware and software design, documentation, assembly, test, installation, field testing, startup, training, and final documentation for the North Chicago Lift Station Instrumentation and Control System.

B. This section covers work necessary for the hardware and software design, documentation, assembly, test, installation, field testing, startup, training, and final documentation for the Master SCADA system upgrades at the City of South Milwaukee Waste Water Treatment Facilities for the North Chicago Lift Station.

C. This section covers work necessary for the hardware and software design, documentation, assembly, test, installation, field testing, startup, training, and final documentation for the SCADA radio-based Network upgrade at the city's lift stations, conveyance sites.

D. This section covers work necessary for the hardware and software design, documentation, assembly, test, installation, field testing, startup, training, and final documentation for the Master SCADA system upgrades at the City of South Milwaukee Waste Water Treatment Facilities for the SCADA radio-based Network upgrade at the city's lift stations, conveyance sites.

E. This section covers work necessary for the hardware and software design, documentation, assembly, test, installation, field testing, startup, training, and final documentation for a new Master SCADA computer system at the City of South Milwaukee Waste Water Treatment Facilities.

F. The Instrumentation and Control System provider shall be responsible for providing and integrating systems specified in this section and the following sections:
Section 13321: SCADA COMPUTER AND SOFTWARE
Section 13322: PLC SYSTEMS
Section 13323: RADIO SYSTEM
Section 13325: CONTROL PANEL ENCLOSURE CONSTRUCTION
Section 13326: CONTROL PANEL MOUNTED INSTRUMENTS AND DEVICES
Section 13327: FIELD MOUNTED INSTRUMENTS AND DEVICES

G. Major components of this system shall include the software, materials, equipment, and installation required to implement a complete and operational Instrumentation and Control System along with any associated electrical enclosures, field mounted instrumentation and associated electrical work.

H. In order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service, to the greatest extent possible, like items of equipment provided hereunder shall be the end products of one (1) manufacturer.

I. Requirements for the electrical work associated with the installation of the system and associated instrumentation and control equipment are as specified in Division 16000 ELECTRICAL.

1.2 RESPONSIBILITY FOR COMPLETE SYSTEM

A. The Systems Integrator shall be responsible for and shall provide for the design, supply, delivery, installation, certification, calibration, adjustment, software configuration, testing, startup, owner training, warranty and routine future field services, of a complete coordinated Instrumentation and Control System which shall perform the specified functions.

1.3 SUBMITTALS

A. Hardware Submittals: Before any components are fabricated, and/or integrated into assemblies or shipped to the job site, furnish to the Engineer for their review submittal documents in accordance with Section 01330. Submittals shall include full details, shop drawings, catalog cuts and such other descriptive matter and documentation as may be required to fully describe the equipment and to demonstrate its conformity to these specifications. Specifically, the Contractor shall submit the following materials:
   1. Block diagram and operational description of the system showing all major components and their interconnections and interrelationships. Label each diagram and specify all external power and communications interfaces. All diagrams shall be in an 11 by 17 format.
   2. Drawings of equipment to be supplied shall include, as a minimum: overall dimension details for each panel, console, etc., including internal and external arrangements and door mounted operator devices with nameplate designations. Wiring diagrams of equipment including field device connections shall be included and specific installation/wiring requirements identified.
   3. Provide a detailed Bill of Materials along with descriptive literature identifying component name, manufacturer, model number, and quantity supplied.

B. Software Submittals: Before any components are fabricated, and/or integrated into assemblies or shipped to the job site, furnish to the Engineer submittal documents in accordance with Section 01330. Submittals shall include catalog cuts and such other descriptive matter and documentation as may be required to fully describe the software and its configuration in order to demonstrate its conformity to these specifications. Specifically, the Contractor shall submit the following materials:
   1. Manufacturer data sheets for PLC and HMI and Radio system configuration software.
   2. Local and Master HMI screen layouts.

C. Test Outlines and Procedures Submittals: Test descriptions shall be in sufficient detail to fully describe the specific tests to be conducted to demonstrate conformance with this specification.

D. Spares and Expendable Recommendations: The Contractor shall provide a list of recommended spares and expendable items. The list shall be exclusive of any spares furnished under this Contract. A total purchase cost for the recommended list shall be provided in addition to the unit cost for each item.

1.4 ON SITE SUPERVISION

A. The Contractor shall provide experienced personnel to supervise, perform, and coordinate the installation, adjustment, testing, and startup of the system. The personnel shall be present on-site as required to affect a complete and operating system.

1.5 TESTING AND STARTUP

A. All elements of the Instrumentation and Control System shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification.

B. All system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly. Each function shall be demonstrated to the satisfaction of the Owner and Engineer on a paragraph-by-paragraph basis.

1.6 TRAINING

A. The training program shall educate operators, maintenance, engineering, and management personnel with the required levels of system familiarity to provide a common working knowledge concerning all significant aspects of the system being supplied.

B. Provide Two One Half Day training classes on the Operation and Maintenance of the new Instrumentation and Control System. Operators shall be trained on all new Operator Interface Screens.

1.7 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall provide O&M manuals in accordance with Section 01730. In addition to "as-built" system drawings, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under this section.

B. The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing and maintenance of each component and/or instrument.

C. Operation and Maintenance manuals shall include copies of all PLC programs written to accomplish the monitoring and control functions specified. Programs shall be updated after startup is complete, with the program(s) provided to the Owner on CD or DVD.

D. The contents of the O&M manuals shall be generally organized as follows:
   1. System Hardware/Installation
   2. System Software
   3. Operation
   4. Maintenance and Troubleshooting

1.8 DEFINITION OF ACCEPTANCE

A. System acceptance shall be defined as that point in time when the following requirements have been fulfilled:

1. All O&M documentation has been submitted, reviewed and approved.
2. The complete Instrumentation and Control System has been successfully completed with all testing requirements completed.
3. All Owner's staff personnel training has been completed.
4. Owner/Engineer sign a document indicating Instrumentation and Control System has formally been accepted.

1.9 APPROVED SYSTEMS INTEGRATORS

A. Allen-ICS, East Troy, WI

B. Altronix - L.W. Allen, Inc., Madison, WI

C. Energenecs, Saukville, WI

PART 2 PRODUCTS

2.1 GENERAL

A. The functions and features specified herewith are the minimum acceptable requirements for the Instrumentation and Control System. The provided system shall equal or exceed each requirement.

B. In some cases, the specifications may allow the accomplishing of certain functions by means of more than one hardware/firmware/software approach. Any approach that is proposed shall equal or exceed all functional, operational, convenience and maintenance aspects of the one described.

C. Major equipment, component and software items are specified; however the Contractor shall, at no additional cost, provide all appurtenant items, whether specifically referenced herein or not, but which may be required for operation as hereinafter specified.

2.2 GENERAL FUNCTIONAL DESCRIPTIONS

A. Instrumentation and Control System to be implemented to provide complete alarm and status monitoring for the North Chicago Lift Station at the South Milwaukee, Wisconsin Waste Water Treatment facility for all process systems as shown on the P&IDs.

B. The new Allen-Bradley Instrumentation and Control System (30-LCP-1-1) shall be interfaced to the existing MCP SCADA Panel and new Wonderware Computer System at the WWTF via a 900 MHz spread spectrum radio system.

C. Provide Alarm and Monitoring screen(s) for each status and alarm shown on the P&IDs.

D. Add additional screen or modify existing screens to reflect changes made to the North Chicago Lift Station.

E. New Pump screens shall display Daily and Accumulated Run Times for each.

F. All screens shall display pertinent Control Power and Communications failure status.

G. The existing SCADAPack PLCs at the listed sites shall have their existing serial telephone modems replaced with 900 MHz spread spectrum radio links.

1. 17th & Oak Relief LS, 801 17th Ave.
2. Chestnut Relief LS, 1610 Chestnut St.
3. Lake Dr. LS, 400 Lake Dr.
4. Lift Station #6, 3001 5th Ave.
5. Missouri LS, 1520 Missouri Ave.
6. Ravine LS, 2309 Third Ave.
7. Siphon Crossing/Marquette Relief LS, 1530 Marquette Ave.
8. Southeast/Edgewood LS, 299 Edgewood Ave.

H. Provide a complete radio repeater station with antenna on the top of the South Milwaukee water tower located at 1400 13th Ave.

I. Replace existing SCADAPack master PLC in the WWTF operations building with a new Allen Bradley MicroLogix 1400 PLC.
1. New Allen-Bradley 1400 PLC to be installed in existing Main Control Panel (MCP) in the operations building.
2. Remove SCADAPack master PLC and Master SCADA Panel after all signals have been migrated to the new Allen-Bradley MicroLogix 1400 PLC.

J. Provide programming changes to existing remote site SCADAPacks as necessary to interface radio system to master PLC and Wonderware computer system.

K. New master PLC and Wonderware Computer system to be programmed to pole and provide operator interface to all remote sites and bring back all existing SCADA monitored parameters.

L. New master PLC and Wonderware Computer system to be programmed to pole and provide operator interface to the new North Chicago Lift Station and provide all parameters shown on P&IDs and provide all functionality described in the specifications.

M. New master PLC and Wonderware Computer system to be programmed to provide and display Daily and Accumulated Run Times for all lift station pumps.

N. New master PLC and Wonderware Computer system to be programmed to provide and display Control Power and Communications failure status for all remote sites.

O. In addition to existing alarm and status indications, SCADAPacks to be programmed to allow the Master PLC and Wonderware SCADA Computer to display Daily and Accumulated Run Times for all lift station pumps.

P. In addition to existing alarm and status indications, SCADAPacks to be programmed to allow the Master PLC and Wonderware SCADA Computer to display Control Power and Communications failure status for all remote sites.

Q. Update existing dialer program and provide new dialer hardware connections as necessary.

2.3 30-LCP-1-1 NORTH CHICAGO LIFT STATION CONTROL PANEL

A. 30-LCP-1-1 shall collect new and existing status, alarm and analog signals as shown on P&IDs. 30-LCP-1-1 shall also provide control for the North Chicago Lift Station pump VFDs.

B. The North Chicago Lift Station Pumps shall be controlled as follows:
   1. North Chicago Lift Station Pump Control panel shall provide all the functions as described in these specifications and as shown on the P&IDs.
   2. The North Chicago Lift Station Pump Control Panel shall utilize a Programmable Logic Controller (PLC) and a front of panel mounted Touchscreen for operator interface to the panel.
   3. The North Chicago Lift Station Pumps Control Panel shall have two independent control systems as follows:
      a. PLC/Touchscreen level control system which uses LIT 1-1 as the level control input.
      b. Hardwired Backup Level control system which utilizes the two floats (LSL-1-1, LSH-1-1) as the control inputs and system alarms.
   4. The PLC control system shall be a Touchscreen 4-stage raw sewage pump matrix which operates as follows:
      a. Allows starting and stopping of any of the pumps at any level stage.
      b. Provides level setpoint entry for each stage.
      c. Provides low level setpoint entry which will stop all pumps.
      d. When the stage 1 pump is started, the pump shall start at minimum speed. As level in wetwell increases to next level stage pump shall ramp up in speed and shall be at maximum speed when second stage level is reached. When the second stage level is reached the second pump will start and the pumps will ramp up and down in the same control band and at the same speed to maintain wetwell level.
      e. Pumps are to stop one at a time when both running pumps are at minimum speed after an operator adjustable time delay for each stage pump.
      f. Provide operator adjustable maximum run timers and pump speed setpoints for each pump.
      g. Display wetwell level at the Touchscreen as well as at the plant SCADA Computer.
      h. Provide operator selectable pump exercise routine for Pumps 2, 3, and 4.
         1) After an operator selectable period of time (0.1-200 hours) the PLC will allow the wetwell level to rise to an operator selectable “Exercise Start Level”.
         2) One pump will run at full speed until the wetwell level drops below an operator selectable “Exercise Stop Level”.
         3) The called pump will automatically alternate between Pumps 2, 3, and 4 for each exercise cycle.
         4) The normal 4-stage PLC pump control scheme will be suspended during an exercise cycle.
   5. The PLC level control system shall normally control the pumps. A relay based, hardwired Float Backup Level control system shall control the pumps in situations where the PLC or level transmitter experiences a failure, etc. The hardwired backup shall take over in the event of PLC Failure or if the wetwell level reaches LSH-1-2 or LSL-1-1. In Float Backup mode, LSH-1-2 will turn the

lead pump on, and LSL-1-1 will stop all pumps. Additional pumps will continue to time on as long as LSH-1-2 is up. Pump order will be selected by a 4-position switch on the front of the control panel. Pump start delay relays will be operator adjustable. Float Backup shall stay running until the Reset button is pushed on the touchscreen.

6. Individual Pump Run, VFD Fail, Motor Overtemperature, and Pump Seal Failure signals shall be displayed on the Local HMIs and the Plant SCADA.
7. Pump Run Times shall be displayed on the Local HMIs and the Plant SCADA.
8. Pumps will be supplied with MiniCAS pump protective relays. These relays are to be installed in the Control Panel and hardwired into the Pump start command circuit to prevent the pump from operating during High Temp Alarm or Seal Alarm. Alarms will automatically reset upon return of normal conditions. Relay to be interfaced with the PLC for Seal Alarm, High Temp Alarm, and High Temp Reset.
9. Control panel will have a 4-position switch for selecting pump order when operating in float backup.

PART 3 PART 3 EXECUTION

3.1 GENERAL

A. Coordinate all work with the engineer/owner to avoid conflicts, errors, delays and unnecessary interference with operation of the existing system during installation, testing, cutover and startup.

B. Install all new equipment in accordance with the manufacturer's instructions and approved submittals.

END OF SECTION

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SECTION 13321

SCADA COMPUTER AND SOFTWARE

PART 1 GENERAL

1.1 This specification covers the technical requirements for the fabrication, engineering, software installation, software development, software configuration, wiring and installation of a new SCADA computer, Wonderware Software upgrade or replacement, and the addition of Wonderware Historian Server Software and configuration.

1.2 All Wonderware software shall be the latest versions available.

1.3 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. General Conditions
   2. Section 13320: GENERAL INSTRUMENTATION AND CONTROL SYSTEM

B. Section specific submittals:
   1. Computer cut sheets and manufacturers specifications.
   2. Computer Operating System, Wonderware Development Studio and Historian cut sheets including version numbers.

PART 2 PRODUCTS

2.1 SCADA COMPUTER HARDWARE

A. Computers and Peripherals
   1. Provide new computer system to function as workstation to replace existing SCADA computer.
   2. Computer hardware system shall consist of a CPU, minimum 2 TB SATA hard disk drive, Optical disk drive that supports DVD+/- RW, telephone modem and all other hardware required to interface to all new and existing equipment on SCADA network.
   3. A minimum of 2 serial ports and 6 USB ports or 8 USB ports with 2 USB to serial adapters shall be provided.
   4. All computer hardware must be listed on the Windows 10 compatibility list published by Microsoft Corporation.
   5. ROHS Compliant Lead Free Motherboard and Chassis.
   6. 16 GB Memory Minimum. Memory to be 1600 Mhz minimum.
   7. 100 Mbps Ethernet adapter.
   8. 3 Year Warranty.
   9. Power provided to the computer and its peripherals will be 120 VAC, 3 wire, 60 Hz. Computer shall be capable of operating satisfactorily in an ambient temperature range of 50 to 104 F with a relative humidity of 5 to 85% non-condensing.
   10. Keyboard, Mouse and Speakers to match manufacturer of Computer.

11. All necessary communications and power cabling and/or cords between the PC, Master PLC, UPS and all peripheral equipment shall be included. Provide surge protected power bar(s) as required.

B. CPU

1. Computer shall be a 64 bit unit in an ATX configuration. CPU shall be an Intel Core i7 quad core -3.0 GHz or better. Power supply shall be at least 650 watts.
2. Included shall be an industry standard 101 key QWERTY type keyboard. Keyboard shall include 12 programmable function keys, an 18 key numeric keypad and separate cursor and screen editing keys. Indicating lights shall be included on the keyboard to indicate the current status of the Cap Lock, Num Lock and Scroll Lock functions.
3. An optical scroll mouse shall be provided to operate in conjunction with the Main Video Display to allow the selection of operational tasks, eliminating most typing functions, and saving operator time.

C. Disk System

1. Hard disk drive system shall contain as a minimum one 2 TB SATA Drive, 6Gb/s 7200 RPM.
2. DVD +/-RW disk drive shall be internally mounted.

D. Video Display System

1. Monitor shall be 22" LED and be same manufacturer as computer.

E. Approved Manufacturers

1. As recommended by Wonderware.

2.2 OPERATING SYSTEM

A. Operating system for computer shall be MS-Windows 10 pro and as recommended by Wonderware.

B. Latest version of MS Office including as a minimum Word, Excel and Access.

C. Anti-Malware and Anti-Virus software to protect computer system.

2.3 SOFTWARE

A. Provide Wonderware InTouch Development Studio licensed to City of South Milwaukee.

B. Provide Wonderware Historian Server licensed to City of South Milwaukee.

C. Provide all other required software and configuration services to reproduce existing SCADA Displays, control and alarming functions on new SCADA computer for both WWTP processes and all remote lift stations and conveyance sites.

D. In addition, provide Daily and previous day displayed run times and daily and previous day number of starts for all pumps and equipment for both WWTP processes and all remote lift stations and conveyance sites.

E. Provide all other required software and configuration services to produce new SCADA Displays, control and alarming functions as required to implement new radio SCADA system.

F. Provide all other required software and configuration services to produce new SCADA Displays, control and alarming functions as required to implement SCADA at the North Chicago Lift Station.

G. Provide, load, and configure software to maintain night and weekend emergency notification system(s).

H. Provide Historian database configuration as follows:
   1. Time Stamped pump and equipment run status for WWTP, remote lift stations and conveyance sites.
   2. Equipment run times for all pumps and equipment at WWTP, remote lift stations and conveyance sites.
   3. Daily and previous day displayed run times and daily and previous day number of starts from display screens.
   4. Time stamped alarms and status signals for WWTP, remote lift stations and conveyance sites. (Examples: Valve and Gate Positions, Generator, ATS, Security and Environmental status and alarm signals.)
   5. All analog values on system including but not limited to wetwell levels, flow indications, dissolved oxygen levels, pump speeds for WWTP, remote lift stations and conveyance sites.

I. Provide Historian trend screen configurations as follows:
   1. WWTP plant influent and effluent flows.
   2. WWTP wetwell and tank levels.
   3. Lift Station and Conveyance wetwell levels.
   4. Lift Station and Conveyance flow values.
   5. Plant RAS and WAS flow rates.
   6. Plant dissolved oxygen levels.

J. Provide Historian report configurations as follows:
   1. DNR reports, both automatic and manual entry data sheets and forms.

PART 3 EXECUTION

3.1 GENERAL

A. Coordinate all work with the engineer/owner to avoid conflicts, errors, delays and unnecessary interference with operation of the existing system during installation, testing, cutover and startup.

B. Install all new equipment in accordance with the manufacturer's instructions and approved submittals.

END OF SECTION

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SECTION 13322

PLC SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for the Programmable Logic Controller (PLC) Systems as described in the Specifications and as shown on the Drawings.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLERS

A. PLC shall meet national and international standards including DIN, UL, CSA, FM and ISO 9001.

B. PLC shall be MicroLogix 1400, with all required serial and ethernet ports and serial Modbus enabled.

C. PLC's shall consist of a CPU with adequate memory, instruction set, power supplies, local and remote input/output modules, communications modules and hardware, and all other components required to make the unit perform all of the functions required.

D. System components including CPU, power supply, signal modules, function modules and communications modules shall be DIN rail mounted.

E. Modules shall include an integrated backplane bus, with connecting cables fixed in place by cover protected screw-type connectors.

F. Discrete Input Cards: 1762-IQ16

G. Discrete Output Cards: 1762-OW16

H. Analog Input Cards: 1762-IF4

I. Analog Output Cards: 1762-OF4

J. Communication Cards: As required to provide communication with WWTP PLC.

K. PLC programming shall be via Microsoft Windows based software. All PLCs shall be programmed with the same software package.

L. One licensed copy of programming software loaded on one of the new computers shall be provided with the system to the owner. Provide license, manuals, programming cable(s) and program CD(s) in a three-ring binder with computer.

M. PLC Manufacturer: Allen-Bradley(Rockwell)

2.2 OPERATOR INTERFACE TERMINALS

A. Unit shall be capable of displaying process variables, fault messages, and provide process control using touch-screen programmed keys. A built-in interface port shall allow connection of a printer for printing hard copy and message printouts. Furnishing of the printer itself is not required under this contract.

B. Color Graphic Screen Type.

C. Provide adequate memory for all specified functions.

D. Control shall be via touch screen technology.

E. Units shall be Color with a minimum screen size of 10-inch-wide screen or larger.

F. Display programming shall be via Microsoft Windows based software. All Operator interface terminals shall be programmed with the same software package.

G. One licensed copy of programming software shall be provided with the system to the owner. Provide license, manuals, programming cable(s) and program CD(s) in three ring binders.

H. Acceptable Operator Interface Manufacturers: Maple Systems, Allen Bradley, PLC Direct.

PART 3 EXECUTION

A. NOT USED

END OF SECTION

SECTION 13323

RADIO SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for the fabrication, engineering, wiring and installation for radio system as described in the Specifications.

B. Provide antenna cabling, antenna, antenna lightning arrestor protection, antenna mounting hardware, antenna mounting structure, radio power supply, data cabling and connectors.

C. Provide a complete radio and antenna system at each of the sites listed in the PATH STUDY section of this specification.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCTS

2.1 RADIO TRANSCEIVER

A. Radio Transceivers shall be 900Mhz Unlicensed Serial and Ethernet Enabled Radio for use at the South Milwaukee Waste Water Treatment Facility, and at the City Water Tower Repeater and at the Lift Station and Conveyance Sites. Radio will be the latest model available from the manufacturer.

B. Approved Manufactures:
   1. FreeWave
   2. Or Approved Equal

C. Radios shall have both serial and ethernet communication modes simultaneously.

D. Radios shall be capable of serial Modbus ASCII and serial Modbus RTU communications. Radios shall also be capable of Allen-Bradley serial and Ethernet protocols.

E. All radio connections shall be via plug-in connectors. This requirement applies to the coaxial cable feed line, antenna connections, lightning arrestor connections, radio power and data connections.

F. Provide all required Programming software, Diagnostic software and Programming cable.

2.2 ANTENNA SYSTEMS

A. Furnish and install a YAGI directional antenna on the top of an antenna structure at each Lift Station and conveyance remote site.

B. Furnish and install an OMNI and or YAGI antenna on top of a radio antenna tower structure at South Milwaukee WWTF as determined by the radio propagation study. If tower is not required per study, provide antenna system per drawing details.

C. Furnish and install a radio repeater and OMNI antenna on top of the city's 1400 13th Avenue Water Tower.

D. All antennas structures shall be as high as required to provide reliable communications between remote site and WWTF.

E. All antennas and supporting structures shall be designed to withstand a 90 MPH wind with a 3/4" coating of ice.

F. Antenna cable:
   1. For antenna, Cables shall be LMR-400 or better as required to provide a solid communication link between the Antennas and Radio.
   2. For towers, Cables shall be LMR-500 or better as required to provide a solid communication link between the Antennas and Radio.

G. Provide main antenna copper wire ground system with 10Ft. ground rod.

H. Provide lightning arrestor mounted in enclosure where radio is mounted.

I. Provide 2-hour UPS for all radios installed. Existing sites which do not have 2-hour battery/UPS capacity shall be upgraded to meet requirement.

2.3 PATH STUDY

A. The system supplier shall include performing a path study for the new radio network. The study will utilize:
   1. Area topographic maps
   2. Site names/locations and addresses
   3. Site ground and antenna elevations
   4. Latitude and Longitude for each site
   5. Approximate path length

B. Sites included:
   1. South Milwaukee WWTF, 3003 5th Ave.
   2. 17th & Oak Relief LS, 801 17th Ave.
   3. Chestnut Relief LS, 1610 Chestnut St.
   4. Lake Dr. LS, 400 Lake Dr.
   5. Lift Station #6, 3001 5th Ave.
   6. North Chicago LS, 1498 North Chicago Ave.
   7. Missouri LS, 1520 Missouri Ave.
   8. Ravine LS, 2309 Third Ave.

9. Siphon Crossing/Marquette Relief LS, 1530 Marquette Ave.
10. Southeast/Edgewood LS, 299 Edgewood Ave.
11. Water Tower, 1400 13th Ave.

C. Where the path study indicates marginal or worse signal loss between a remote site and the WWTF tower, provide alternate path data using other remote sites as repeaters that will allow for a stronger signal.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 13325

CONTROL PANEL ENCLOSURE CONSTRUCTION

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for the fabrication, engineering, wiring and installation for instrumentation, control and electrical enclosures as described in the Specifications and as shown on the Drawings.

B. Panels provided under this section shall meet the requirements of UL-508. All panels shall bear the UL-508 serialized label or be third party certified when delivered to the job site. All field modifications shall be in conformance with UL-508. When the Owner accepts the panels, the contractor shall certify that the panels have retained their UL labeling or third-party certification.

C. All wiring shall be in complete conformance with the National Electric Code, state, local and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCTS

2.1 GENERAL

A. All outdoor enclosures shall be NEMA 4X stainless steel, provided with stainless steel pedestal if not mounted on wall or other surface.

B. For outdoor enclosures mounted in areas where exposed to sunlight, provide sunshields. Sunshields to be designed to keep internal panel temperature below the temperature rating of the internal installed components.

C. All indoor enclosures shall be NEMA 12, except in corrosive atmospheres indoor panels shall also be NEMA 4X stainless steel.

D. All conduit entry into the enclosures shall be sealed with non-hardening sealing compound.

E. Condensation protection shall be provided. Enclosure shall have a heater which operates continuously to prevent condensation build-up. Exception to this requirement may be given if panel is in an electrical room with heating and air conditioning.

F. Enclosures shall be provided with internal heaters, heater thermostats, heat pipe type air to air heat exchangers, heat exchanger thermostat as necessary to main internal panel temperatures between 40 and 104 Degree F.

G. All equipment in enclosures shall operate from single 120 Vac power supply circuit. (If panel contains motor controls, panel shall have a single supply at the voltage of the motor controls. Provide control transformer as necessary to provide control panel with 120Vac control voltage.)

H. Acceptable enclosure manufacturers:
1. Hoffman Engineering Company
2. Saginaw Control & Engineering
3. Or approved equal

I. Acceptable heater manufacturers:
1. Hoffman Engineering Company
2. Or approved equal

J. Acceptable heat exchanger manufacturers:
1. Hoffman Engineering Company
2. Noren Products Incorporated
3. Or approved equal

2.2 PANEL CONSTRUCTION

A. NEMA 12 Enclosures
1. NEMA 12 enclosures shall be fabricated from 12 gauge cold rolled sheet steel or better.
2. Stiffening members shall be provided for strength and stiffness as required.
3. Seamless welded construction shall be used throughout. All exposed seams shall be continuously welded and ground smooth.
4. Lifting rings shall be provided for panels in excess of 100 pounds.
5. Double doors shall be of the flush type construction with continuous hinge and gasketing.
6. Doors shall be equipped with two (wall mounted) or three (floor mounted) point latching mechanism.
7. A hasp and staple shall be provided for padlocking.
8. Subpanels shall be provided, and mounting shall be designed for easy removal.
9. A print pocket shall be attached to the inside of each door.

B. NEMA 4X Enclosures
1. NEMA 4X enclosures shall be fabricated from 14 gauge stainless steel or better.
2. Stiffening members shall be provided for strength and stiffness as required.
3. Seamless welded construction shall be used throughout. All exposed seams shall be continuously welded and ground smooth.
4. Lifting rings shall be provided for panels in excess of 100 pounds.
5. Enclosure door shall be provided with neoprene gasket, which shall be attached to the enclosure with oil-resistant adhesive, and held in place with stainless steel retaining strips.

6. Door clamps shall be provided on three sides of the enclosure door. (EXCEPTION: Panels with internal swingout doors shall be provided a single door handle to allow easy access to swingout door mounted operator interface devices.)
7. A hasp and staple shall be provided for padlocking.
8. Subpanels shall be provided as required, and its mounting shall be designed for easy removal.
9. Corrosion inhibitors and breather drains shall be furnished for condensation and corrosion control inside the panel.
10. A print pocket shall be attached to the inside of each door.

2.3 PANEL GROUNDING

A. Each enclosure shall be provided with an isolated ground connection or buss, which shall be tied to the installation grounding system, through a #6 AWG insulated grounding conductor, only at the final connection to the ground rods.

2.4 PANEL WIRING

A. Wiring within the enclosure shall be continuous and shall be terminated only at terminal blocks or equipment terminals.

B. Not more than two wires shall be terminated at any terminal block.

C. Wiring splices and wire nuts will not be permitted within the enclosure.

D. Wiring within the enclosure shall be protected as follows:
1. In general, all wiring within the enclosure shall be put in plastic wiring ducts such as panduits.
2. Wiring outside of the ducts shall be restrained by means of plastic ties.
3. Wiring passing a door hinge shall be grouped and wrapped in a protective wire harness.
4. Provide abrasion protections for any wire bundles passing through holes or across sheet metal edges.

E. In general, wiring within the enclosures shall be as follows:
1. Control wiring within the enclosure shall be #18 AWG stranded.
2. Wiring for long distance DC signals shall be #18 AWG stranded.
3. Wiring for 4-20 mA DC analog signals shall be #18 AWG twisted shielded pair.
4. Multi-conductor control cables and shielded pair cables between control equipment, control panels and motor starters shall be rated for 600 Volts.

F. Wiring within the enclosure shall follow the following color convention:
1. Neutral conductor shall be white.
2. Hot or phase conductor shall be black.
3. Grounding conductor shall be green.
4. AC control wiring shall be orange
5. DC (+) power conductor shall be red.
6. DC (-) power conductor shall be black.
7. DC control wiring shall be blue

8. Current Loop wiring shall be twisted shielded pair cables.

G. AC and DC wiring shall be separated from each other. Where AC and DC wire runs parallel, the minimum separation between them shall be 4 inches. Where AC and DC wire runs across, they shall cross at 90 degree intersections. Provide separate panduit for AC and DC wiring.

H. Equipment and signal ground wiring, as well as Neutral wiring shall not be daisy-chained. They shall each be terminated at isolated, bused terminal blocks.

I. Each conductor end shall be terminated at a terminal block or at an equipment wiring terminal. Each terminal block shall have a unique identification number. The terminal blocks shall be arranged and numbered in consecutive order, based on standard alphanumeric order.

J. Terminal blocks within each enclosure shall be grouped as follows:
1. 120 Volts AC power
2. 120 Volts AC control wiring terminal blocks
3. AC isolated Neutral Busbar terminations
4. 24 Volts DC power terminations
5. 24 Volts DC control wiring terminal blocks for discrete signals
6. 24 Volts DC Common Busbar terminations
7. Analog signal wiring terminal blocks (for 4 - 20 mA DC signals)
8. Isolated Grounding Busbar terminations

K. Provide 25% spare terminal blocks, (minimum of 6), for each type used in each enclosure.

2.5 TERMINAL BLOCKS

A. Terminal blocks within enclosures shall be of the high density modular types, constructed of nylon material, suitable for mounting on standard DIN rails. Termination type shall be tubular screw with serrated pressure plate.

B. All current carrying parts (metal bodies) shall be made of nickel/tin-plated copper.

C. Ground terminals shall be color coded in accordance with international standard, which shall be yellow/green.

D. Panel power distribution and digital output terminal blocks shall be fused lever disconnect type with illuminated blown fuse indication.

E. The terminal block system shall be as manufactured by Phoenix Contact or equal.

2.6 PANEL POWER DISTRIBUTION REQUIREMENTS

A. Panels shall always be designed to have one power supply source. If supply voltage is higher than 120Vac a control transformer with 100% spare capacity shall be supplied.

B. One GFI Service outlet shall be supplied inside each panel.

C. Panels with Uninterruptible Power Supply (UPS) shall be designed such that if the UPS system fails a contactor at the output of the UPS shall transfer the panels UPS powered loads back to the panels Utility power supply. Panel shall provide a "UPS Fail" contact closure alarm prewired to a terminal strip for connection to the SCADA system or other alarm system.

2.7 PANEL ACCESSORIES

A. Each enclosure that requires cooling shall be provided with a thermostat and a thermostatically controlled air-to-air heat exchanger.

B. Each enclosure shall be provided with internal panel LED lights, which shall be provided with and actuated through a door light switch. The lights shall turn on automatically when the enclosure door is opened and turn off automatically when the enclosure door is closed. The panel lights shall be strategically placed to provide maximum possible illumination coverage of the panel/enclosure interior.

C. The enclosure vendor shall be responsible for all interposing relays which may be necessary to interface all field equipment or Motor Control Centers, to provide a complete functional system.

D. The enclosure vendor shall be responsible for all intrinsic safety relays and panel construction methods which are necessary to interface with field equipment and instruments that are mounted in explosion hazard areas. See NEC and NFPA 820 for requirements.

E. The enclosure vendor shall be responsible for all analog signal boosters and isolators which may be necessary to interface all field instrumentation equipment or Motor Control Centers, to provide a complete functional system.

F. Current to current isolators shall be furnished and installed as required, to eliminate interface and ground loop problems. Inputs shall be 4 - 20 mA DC. Outputs shall be 4 - 20 mA DC isolated, into at least 800 Ohms. Power to the isolators shall be 115 Volts AC, 60 Hertz.

G. The enclosure vendor shall be responsible for providing and sizing all instrument loop power supplies. The enclosure vendor shall be responsible for providing and sizing all PLC and Operator Interface Power Supplies. The power supplies shall be sized to include at least 100% spare capacity. Where PLC manufacturer and Operator Interface Manufacturer's recommend separate power supplies for isolation or other reasons separate power supplies shall be provided.

H. PLC, Operator Interfaces, radio and each type of I/O shall have separate fusing or breakers as required by manufacturer instruction manuals or as necessary to eliminate electrical ground loops or electrical/communication noise.

I. Provide communication port optical isolation as necessary to ensure proper communications between networked devices.

2.8 EQUIPMENT IDENTIFICATION AND WIRE TAGGING

A. All panel wiring shall be identified by means of heat shrink type wire markers.

B. All communications cabling shall be identified by means of heat shrink type wire markers.

C. Each component mounted within the enclosure shall be provided with equipment identification. Equipment and device nameplates or identification shall be of engraved laminated plastic, black lettering on white background or similar professional looking identification.

PART 3 EXECUTION

A. NOT USED

END OF SECTION

SECTION 13326

CONTROL PANEL MOUNTED INSTRUMENTS AND DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for panel mounted instruments and devices.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCT

2.1 INSTRUMENT INDEX

A. Furnish, install, engineer, wire, adjust, test, start-up, commission, and train operations personnel for panel mounted control devices as listed below.

2.2 PUSH BUTTONS, SELECTOR SWITCHES, PILOT LIGHTS

A. General Specifications
   1. All panel mounted control devices shall be of the industrial grade, heavy duty, watertight/oil tight types. They shall be rated NEMA 4, 4X and 13, corrosion resistant. In explosion hazard areas they shall be rated NEMA 7.
   2. Each panel mounted control device shall be provided with three ply engraved laminated plastic, (white-black-white) legend plate. The legend plate size shall be 2-1/2" by 2-1/2" nominal.
   3. Each panel mounted control device shall be provided with an engraved laminated plastic nameplate on the rear of the device, mounted on the inside of the enclosure door.

B. Push Buttons and Selector Switches
   1. Contact ratings shall be as follows:
      a. Make: 60 Amperes at 120 Volts AC (7200 VA), at 35% power factor
      b. Break: 6 Amperes at 120 Volts AC (720 VA), at 35% power factor
      c. Continuous: 10 Amperes at 120 Volts AC, at 75% power factor
   2. Guards shall be provided as follows:
      a. Stop momentary push buttons: Full guard types
      b. Start momentary push buttons: Extended guard types
      c. Lamp test momentary push buttons: No guard
   3. Emergency Stop push buttons shall be of the maintained push-pull types, provided with mushroom illuminated button.

4. Button colors shall be as follows:
    a. Start button: Red
    b. Stop button: Green
    c. Emergency stop button: Red, illuminated
    d. Lamp test button: Black
    e. Selector switch: Black

C. Pilot Lights
1. All pilot lights shall have LED light units.
2. Pilot lights shall be of the push-to-test types.
3. Color caps shall be as follows:
    a. Motor ON: Red
    b. Motor OFF: Green
    c. Motor failure: Amber

D. Manufacturer:
1. Square D, Class 9001
2. Allen-Bradley
3. Or equal

2.3 GENERAL PURPOSE CONTROL RELAYS

A. General Specifications
1. Contacts: Silver Cadmium Oxide, minimum configuration: Double Pole Double Throw or Three Pole Double Throw rated 10 Amps continuous at up to 240VAC, 10 million operation minimum life.
2. Pin and socket configuration: 8-pin or 11-pin tube type, single or double tier, snap mount DIN rail socket.
3. Relays shall have integral pilot lights, which shall be on when its coil is energized.
4. Relay Coils directly connected to Programmable Controller Outputs shall be provided with a shunt load resistor and an MOV type surge protector, or surge diode designed per PLC manufacturer instruction manuals.
5. Manufacturer: Square D, Class 8501, Type K or equal.

2.4 GENERAL PURPOSE TIME DELAY RELAYS

A. General Specifications
1. Contacts: Silver Cadmium Oxide, minimum configuration: Double Pole Double Throw or Three Pole Double Throw, rated 10 Amps continuous at up to 240VAC, 10 million operation minimum life.
2. Transient Protected. 2000Volts for 100us
3. Provide as required in the following configurations:
    a. On Delay
    b. Off Delay
    c. Interval
    d. One Shot
    e. Repeat Cycle
4. Pin and socket configuration: 8-pin and 11 pin socket type, single or double tier, snap mount DIN rail socket.

5. Time Delay Relays shall have integral Knob(s) Adjustment on top of relay which shows timing range.
6. Time Delay Relay Coils directly connected to Programmable Controller Outputs shall be provided with a shunt load resistor and an MOV type surge protector, or surge diode designed per PLC manufacturer instruction manuals.
7. Manufacturer: Square D, Class 9050, Type JCK or approved equal.

2.5 INTRINSIC SAFETY BARRIERS

A. General Specifications
1. DIN rail mounting.
2. Short circuit protected.
3. FM, UL, CSA, approved for application.
4. Shock resistant encapsulated design.
5. Manufacturer: As required by Instrument Supplier, or STAHL, GEM, or approved equal when not specified by Supplier.

2.6 DC REGULATED POWER SUPPLIES

A. General Specifications
1. When DC power supply is required for discrete inputs and 2-wire analog loops, provide linear regulated 24 Volt DC regulated power supplies. Output Regulation to +/- 5% with input of 105 -125Vac.
2. When DC power supplies of other voltages are required, provide as necessary.
3. The power supply shall be sized to include 100 percent spare capacity.
4. Encapsulated with terminal strips, no soldering.
5. Short circuit protected.
6. Overvoltage protected.
7. Manufacturer: Acopian, Sola or equal.

2.7 AC TRANSIENT SURGE PROTECTORS

A. General Specifications
1. DIN Rail Mountable
2. Voltage Input: 120 VAC, 60 Hz, single phase
3. Current Capacity: 30Amp
4. Clamping Voltage: 330
5. Surge Dissipation to 10KA
6. LED replacement indicator light
7. Manufacturer: Citel, Or Equal.

2.8 UNINTERRUPTIBLE POWER SUPPLIES

A. General Specifications
1. Sized to allow a minimum 60 minutes operation. (Minimum of 700 VA)
2. Supplied for all PLCs, Touchsreens and Computers in system. Also, backup to maintain operation of every input and output shown on P&IDs.
3. One-line high frequency double conversion technology.
4. Input Power Factor correction.
5. Sine-wave power output from inverter.

6. External power connector to allow external additional battery connection.
7. 2-year warranty.
8. Battery to be maintenance free sealed leakproof.
9. Fused or circuit breaker input protection.
10. 0-40 Degrees C Operating Temperature.
11. Output to have electronic overload and short circuit protection. Overload 110% for 10sec then automatic transfer to bypass. Bypass transfer time 0ms.
12. Dip switch selectable output voltage 100/110/120/127Vac.
13. Manufacturer: Eaton, Or Approved Equal.

2.9 ETHERNET SWITCHES

A. GENERAL SPECIFICATIONS

1. Ethernet Switches to be powered directly from panel's power supply. Power to be connected directly to Converter. Power connections to be Screw Terminals. Portable calculator type power supplies are not acceptable.
2. Industrial Switches to have Auto Sensing 10/100 BaseTX Ethernet ports.
3. Industrial Switches to be rated for operating temperature of -40 to +80ºC.
4. DIN rail mounting.
5. Manufacturer: N-TRON series 100 or approved equal.

2.10 FIBER TO SERIAL CONVERTER

B. GENERAL SPECIFICATIONS

1. Industrial Serial to Multimode Fiber Optic Converter.
2. Fiber distance up to 4 km.
3. Power connections to be Screw Terminals. 10 to 30 VDC
4. Industrial Bus Modbus ASCII or RTU.
5. Connectors to be type ST
6. Designed for 62.5/125 micro-meter fiber cable.
7. Serial types DIP Switch selectable between RS-232 and RS-422/485 2 and 4 wire.
8. Operating temperature of -40 to +80ºC.
9. DIN rail mounting.
10. Manufacturer: B+B SMARTWORX Model FOSTCDR or approved equal.

END OF SECTION

SECTION 13327

FIELD MOUNTED INSTRUMENTS AND DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for field mounted instruments and devices.

B. Furnish, install, engineer, wire, adjust, calibrate, test, start-up, commission, and train operations personnel for field instrumentation and control devices as listed below.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCTS

2.1 INSTRUMENT INDEX

A. Furnish and install field instrumentation and control devices as listed below and as shown on the drawings:
   1. 13327-2.2 Float Switches
   2. 13327-2.3 Radar Level Transmitter
   3. 13327-2.4 Magnetic Flow Meters
   4. 13327-2.5 Security Key Switches
   5. 13327-2.6 Security Door Alarm Switches
   6. 13327-2.7 Low Temperature Alarm Switches
   7. 13327-2.8 Flood Alarm Switches

2.2 FLOAT SWITCHES

A. General Specifications
   1. The float switches shall be of the normally open or normally closed type switch rated for 20 Amperes at 120 Volts AC.
   2. The float switches shall be constructed of 20 gauge, 316 stainless steel, 5 or 5-1/2 inch diameter sphere permanently assembled to switch cable.
   3. The float switches shall be provided with a grounding wire.
   4. The float switch cable shall be type SO with a Nitrile PVC jacket containing three #14 AWG fine stranded conductors (black, white and green)
   5. Float switches shall be mercury-free construction.
   6. Each float switch shall be provided with all required mounting hardware as specified in the "INSTALLATION NOTES" section.

B. Acceptable Manufacturer
1. Consolidated Electric Company (Model 9G)
2. Anchor Scientific (Rotofloat SST)
3. Or Approved Equal

C. Equipment Data

TAG NO.	PROCESS	P & ID
LSH-1-2	Wetwell High Level	90-I-1
LSL-1-1	Wetwell Low level	90-I-1

D. Installation Notes
1. Install per manufacturer's instructions and in accordance with installation detail.
2. Provide and install a weighted stainless steel cable or chain or wall mounted stainless steel pipe on which the wetwell float switches shall be mounted. See mechanical installation drawings for determining type to be applied to application.
3. Provide and install wall mounted stainless steel pipe on which the building high level float switches shall be mounted.
4. Float switches shall be mounted to the stainless steel cable, chain or pipe with stainless steel brackets and stainless steel U-bolts which are to be manufactured by the float switch manufacturer.
5. All hardware shall be stainless steel including bracket anchors.

2.3 RADAR LEVEL TRANSMITTERS

A. General Specifications
1. Accuracy: ±2 mm
2. Process pressure: -14.5 to 29.0 psig
3. Process temperature: -40 to +176 deg F
4. Ambient temperature: -40 to +176 deg F
5. Vibration resistance
6. With adapter flange 2 g at 5 to 200 Hz
7. Shock resistance 100 g, 6 ms
8. Protection rating NEMA 6P submersible
9. Measuring cycle time 450 ms
10. Step response time ≤3 s
11. Beam angle 10 deg
12. Output signal 4-20mA/HART
13. Integrated real time clock
14. Rated for use in Class 1, Division 1 Group D environments

B. Acceptable Manufacturer
1. Vega WL 61
2. Or Approved Equal

C. Equipment Data

TAG NO.	PROCESS	P & ID
LIT 1-1	Wetwell Level	90-I-1

D. Installation Notes
1. Install per manufacturer's instructions and in accordance with installation detail.

2.4 MAGNETIC FLOW METERS

A. General Specifications
1. 2 Year Warranty
2. Operating Principle: Faraday's Law
3. Excitation Type: bipolar pulsed DC
4. System Accuracy: Plus or minus 0.5% of flow rate, or +/- 0.01%of full scale. Accuracy shall be verified by calibration of each flow meter in a flow laboratory traceable to the U.S. National Bureau of Standards.
5. Each system shall be factory calibrated before shipment. No realignment shall be necessary.
6. Transmitter Integral or Remote as shown under equipment data.
7. Operating Temperature -30 to +60 degrees C
8. Power: 120 Volts AC, 60 Hz. (Provide with surge protection)

B. Primary Element – Meter
1. Power supplied by Transmitter.
2. Minimum 25 ft. of cable supplied with Flow meter.
3. Complete with Grounding electrodes or Grounding rings.
4. Flange Mounted.
5. Submergence Rating 5 Feet.
6. 316 Stainless Steel Electrodes

C. Transmitter
1. 115Vac 60Hz power supply.
2. NEMA 4X Enclosure
3. Remote Mounting
4. Micro-processor based, capable of bi-directional flow, field configurable without any external device.
5. Integral Self Diagnostics
6. Auto integrated zeroing.
7. Local display shall indicate flow rate and total.
8. Memory type: Non-volatile.
9. The converter shall be provided with empty pipe detection system, which shall drive both the analog and digital output signals to zero when the electrodes are uncovered.
10. Isolated powered 4-20 mA output.
11. Pulsed Output for totalization

D. Acceptable Manufacturer(s)
1. Krohne
2. Rosemount
3. Or Approved Equal.

E. Equipment Data

TAG NO	PROCESS	SIZE	TRANS.	P & ID
FE/FIT-2-1	Collections Systems Flow	12”	Remote	90-I-1
FE/FIT-2-2	Collections Systems Flow	12”	Remote	90-I-1
FE/FIT-2-3	Oak Creek Over Flow	12”	Remote	90-I-1

G. Installation Notes

1. Power to the magnetic flow meter shall be through the flow meter transmitter, which shall receive 120 volt AC power through a combination fused disconnect switch and surge protector.
2. Install grounding orifices and grounding system per manufacturer's instructions. Thermoweld grounding jumpers, such that continuous grounding path is achieved between the metal process piping and the grounding orifices.
3. The system shall be installed, wired, and calibrated in strict compliance with the manufacturer's instructions.
4. Calibrate each Flowmeter as follows:
   a. Provide a factory calibration report for each flowmeter, which shall include, but shall not be limited to, the following:
      1) Date and time the final calibration was complete.
      2) List of factory setpoints required for proper meter function.
   b. The names and signatures of personnel performing the calibration.

2.5 SECURITY KEY SWITCHES (ON/OFF)

A. General Specifications

1. Key Switch, 1 NO and 1 NC Maintained Contacts.
2. All switches shall use the same key to operate.
3. Industrial grade, heavy duty, watertight/oil-tight types. They shall be rated NEMA 4, 4X and 13, corrosion resistant. In explosion hazard areas they shall be rated NEMA 7.
4. Provided with three ply engraved laminated plastic, (white-black-white) legend plate. The legend plate size shall be 2-1/2" by 2-1/2" nominal.
5. Contact ratings shall be as follows:
   a. Make: 60 Amperes at 120 Volts AC (7200 VA), at 35% power factor
   b. Break: 6 Amperes at 120 Volts AC (720 VA), at 35% power factor
   c. Continuous: 10 Amperes at 120 Volts AC, at 75% power factor

B. Acceptable Manufacturer

1. Square D Class 9001
2. Or Approved Equal

C. Equipment Data

TAG NO.	PROCESS	P & ID
HS-3-1	Pump Room Door Alarm Disable	90-I-2
HS-3-2	Generator Room Door Alarm Disable	90-I-2

D. Installation Notes

1. All mounting hardware shall be stainless steel.
2. Provide two keys to owner for each switch.
3. Install in NEMA 4X stainless steel box in unrated or outdoor areas. In hazardous areas, box shall be NEMA 7.
4. Install per manufacturer's instructions.

2.6 SECURITY DOOR ALARM SWITCHES

A. General Specifications
1. Square D heavy duty plunger or rocker arm type.
2. Dry contact closure output to feed SCADA system.
3. 1 NO and 1 NC contact. Each rated at 10A, 120Vac.

B. Acceptable Manufacturer
1. Square D
2. Or Approved Equal

C. Equipment Data

TAG	PROCESS DESCRIPTION	P&ID
ZS-3-1	Pump Room Door 1 Open Alarm	90-I-2
ZS-3-2	Pump Room Door 2 Open Alarm	90-I-2
ZS-3-3	Generator Room Door 1 Open Alarm	90-I-2
ZS-3-4	Generator Room Door 2 Open Alarm	90-I-2

D. Installation Notes
1. Provide all mounting hardware and install per manufacturer's instructions.

2.7 LOW TEMPERATURE ALARM SWITCHES

A. General Specifications
1. CSA Certified, UL Listed
2. Adjustable 40-80 Degrees F range setting with 3 Degrees F fixed differential
3. Contact closes on low temperature
4. Fully enclosed snap action switch
5. CSA Certified Contact rating 16A at 120/208/240Vac
6. Control knob on face of thermostat for setpoint adjustment

B. Acceptable Manufacturer
1. Honeywell T498A, B
2. Or Approved Equal

C. Equipment Data

TAG	PROCESS DESCRIPTION	P&ID
TSL-3-1	Pump Room Low Temperature	90-I-2
TSL-3-2	Generator Room Low Temperature	90-I-2

D. Installation Notes
1. Provide all mounting hardware.
2. Install per manufacturer's instructions.

2.8 FLOOD ALARM SWITCHES

A. General Specifications
   1. The float switches shall be of the normally open SPST switch rated at 100VA minimum.
   2. The float switches shall be constructed entirely of 316 stainless steel, 2 inch diameter sphere permanently assembled to switch stem.
   3. Switch to be specifically designed for corrosive service.
   4. Mounting shall be 1/4" NPT.
   5. 24" lead wires, 18 AWG

B. Acceptable Manufacturer
   1. Omega LV-51
   2. Or Approved Equal

C. Equipment Data

TAG NO.	PROCESS	P & ID
LSH-3-1	Pump Room Flood Alarm	90-I-2

D. Installation Notes
   1. Provide all required mounting hardware and install per manufacturer's instructions.

END OF SECTION

SECTION 13790

RADIO ANTENNA TOWER

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work under this section.

1.2 SCOPE

A. This specification outlines the minimum requirements for a triangular galvanized steel tower to support communications antenna.

B. Requirements include the tower erection, tower foundation design and erection, and verification of tower structural requirements.

1.3 SUBMITTALS

A. Detailed assembly drawings shall be submitted in accordance with Division 1 of these specifications. Submittal shall include the following:
   1. Tower layout including structural loadings, assumed wind loadings, part numbers, connection details and overall configuration.
   2. Foundation drawings including structural steel requirements and soil conditions used as a basis for footing calculations.

1.4 QUALITY ASSURANCE

A. Reference standards of the following agencies;
   1. ANSI/EIA-222-D, structural standards for steel antenna towers and antenna supporting structures.
   2. American Society for Testing and Materials (ASTM).
   3. AISC Manual for American Institute of Steel Construction.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. ROHN.

B. Or equal.

2.2 EQUIPMENT

A. Tower shall be self-supported type equivalent to Rohn SSV series.

B. Tower structural members shall be fabricated from angles, solid or tubular members. Tower legs shall be of 50 KSI minimum yield strength material. Braces shall be of minimum 36 KSI angle or tube, or 30 KSI solid rounds.

C. Tubular leg members shall maintain an open interior diameter through the flange plate at least as large as the inside diameter of the pipe.

D. Flanged leg connections shall utilize a minimum of four bolts per leg.

E. A tower shall be designed for the specified maximum sustained wind speed acting on the tower antennas, transmission lines, and associated equipment and for the dead-load of the tower and all materials fastened thereto. The wind speed specified shall be considered the basic speed as defined in ANSI/EIA-222-D. Ice shall be considered as solid radial ice covering all tower members and appurtenances.

F. Tower foundation shall be reinforced concrete and shall be designed for the following conditions: 3000 PSF vertical bearing capacity plus a ½" thick ice load. Verify soil bearing capacity with the Engineer and notify Engineer of any deviation.

G. Total of one 1W boom installation for the mounting of the MATV antenna. Length of assembly shall be as required to extend 6' beyond either side of tower legs. Mount at approximately 5 feet below top of antenna. Provide with two antenna mast kits.

PART 3 EXECUTION

3.1 GENERAL

A. The Contractor shall provide the tower manufacturer with all the required loading factors and the tower manufacturer shall be responsible for tower load calculations and tower foundation design.

B. The Contractor shall retain the tower manufacturer as a subcontractor who shall oversee the construction of the tower foundation and the erection of the tower. All work performed and materials used shall be exactly per the tower manufacturer's direction.

C. The tower manufacturer shall provide written proof that the tower and foundation were installed per their requirements for the loading conditions given.

D. Ground each tower leg as follows: connect each tower leg to a 10 ft copper-cald ground rod, using a #3 AWG grounding electrode conductor. The connection to each ground rod shall be exothermic.

END OF SECTION

SECTION 14600

HOIST AND MONORAIL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hoist and Monorail Systems

B. Major components included, but not limited to:
   1. Trolleys.
   2. Hoists.

1.2 SYSTEM DESCRIPTION

A. The hoist and monorail systems shall be capable of lifting and conveying materials up to weights specified herein. Systems shall be designed to work as an integral part of the building structure.

1.3 REFERENCES

A. American Society of Mechanical Engineers:
   1. ASME B30.2 – 2011: Overhead and Gantry Cranes.
   2. ASME B30.16 – 2012: Overhead Hoists

B. Current OSHA regulations.

C. Monorail Manufacturers' Association (MMA) -Specifications for Underhung Cranes and Monorail System.

D. Hoist Manufacturers' Institute (HMI) Specifications.

1.4 DESIGN REQUIREMENTS

A. General Requirements: Design stresses and safety factors in accordance with CMAA and MMA specifications.

B. Detailed Requirements:
   1. Provide complete trolley and hoist systems as scheduled below for installation on the monorails where shown on the Drawings.
   2. Location: Pump Room.
   3. Capacity, ton: 2.
   4. High Hook Elevation, ft: 643.50.
   5. Operating Floor Elevation, ft: 635.50.
   6. Lowest Hook Elevation, ft: 612.00.
   7. Trolley: Manual.
   8. Hoist: Motorized.

1.5 SUBMITTALS

A. Shop Drawings: Submit data under provisions of Section 01300, including the following:
   1. Complete assembly and installation drawings.
   2. Descriptive information on material and equipment furnished.

B. Furnish operation and maintenance manuals under the provisions of Section 01730.

C. Submit certificates of proper installation and operator training under the provisions of Section 01445.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle the equipment under the provisions of Section 01600.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Electrolift, Inc., Clifton, NJ.

B. Coffing Hoists, Getzville, NY.

C. Or Equal.

2.2 GENERAL

A. All equipment shall be the end product of one hoist system supplier. The supplier shall be responsible for the complete system including all items covered herein.

2.3 METAL FABRICATION

A. Fabricated metal parts described herein shall conform to Section 05500.

B. Anchor bolts, fasteners, nuts, and washers: 316 stainless steel.

2.4 EQUIPMENT

A. Trolley:
   1. Type: Hand-geared.
   2. Service Class: Class A2 per MMA Specifications.
   3. Trolley Frame:
      a. Type: Four wheel.
      b. Construction: Welded steel, cast steel, or ductile iron.
      c. Prevent a drop of more than 1 inch in case of axle failure.
   4. Hand-Geared Trolleys:
      a. Chain sprocket mounted on the trolley drive shaft.
      b. Drive the trolley wheels through a gear and pinion or spur gear arrangement.

c. Chain loop between 4 and 5 feet above the operating level.

5. Wheels:
   a. Construction: Rolled or forged steel with treads and flanges heat treated, or cast iron wheels with chilled tread.
   b. Minimum tread hardness: 170 Brinell.
   c. Bearings: Ball or roller.
   d. All clearances, wheel loads, and manufacturing tolerances shall be in accordance with MMA Specifications.
6. Wheel Axles: Alloy steel.
7. Gears:
   a. Helical, spur, or herringbone type, made from rolled or cast steel.
   b. Machine cut teeth.
   c. 20-degree pressure angle.
   d. Ratings shall be in accordance with AGMA Standards, as described in MMA Specifications.
8. Bearings:
   a. Combination radial and thrust type.
   b. Double-row, angular contact ball bearings, or single-row tapered roller bearings.
   c. Prelubricated and sealed.
9. Trolley Brakes:
   a. For the motion concerned.
   b. Rated torque capacities as specified in MMA Specifications.
10. Provide stops for the trolleys.

B. Hoist:
1. Type: Electric Wire Rope Hoist
2. Design Requirements
   a. Service class: H1 per HMI specifications.
   b. Lifting rate: 10-15 feet/min.
   c. Provide suitable gear reductions and electric motor operator.
   d. Load blocks, hooks, and sheaves shall be included.
   e. Provide dual hoist braking.
   f. Include capacity limit switches to prevent overloading.
   g. Provide adjustable upper and lower safety limit switches for extreme hook positions.
3. Rope Drum:
   a. Rope drum diameter not less than 24 times the diameter of the hoisting cable.
   b. Rope drum shall be grooved to receive the full lift of the hoisting cable without overlapping.
   c. Rope drum shall be of sufficient size and length so at least two turns of the hoisting cable remain on the drum with the hook in its low position.
4. Hoisting rope: Flexible, improved plow steel wire rope made especially for hoist service.
5. Gearing: Combination helical and spur cut teeth, heat treated, running on antifriction bearings in oil bath lubrication or permanently lubricated bearings with splined shafts.
6. Power Supply: 480V, 3 phase, 60 Hz.

C. Lubricate parts and components such as gear boxes and bearings prior to shipment.

2.5 MARKING

A. Permanently mark capacity of hoist and trolley.

2.6 FINISHING

A. Shop and field painting as specified in Section 09900, System No. 5. Verify compatibility of factory and field coats.

2.7 ELECTRICAL EQUIPMENT

A. Furnish all electrical equipment, including motors, motor starters, and controls. All wire on the equipment shall be furnished by the manufacturer, cut to length and installed, as far as practical, before shipment.

B. The electrical equipment shall be in accordance with Division 13, Division 16 and National Electrical Code.

C. Provide NEMA 7 explosion proof electrical equipment in Class 1, Division 1 areas.

D. Festoon Cable:
1. Flat type.
2. Cable and supports shall be capable of storing in a space of not more than 10 percent of the overall monorail length.

E. Hand-held Control Station:
1. Furnish hand-held pushbutton radio control type station with momentary contact pushbuttons for motorized hoist.
2. Provide two rechargeable battery packs with NiMH batteries and battery charger.
3. Provide wall mounted storage rack for control station.
4. Construct pushbutton enclosure of high-impact rubber or steel.
5. Provide control of all motions plus emergency "Stop" button that will disconnect power to all motor circuits.
6. Furnish "Start" button as reset.
7. NEMA 7 explosion proof construction for Class 1, Division 1 areas.
8. Receiver enclosure shall be NEMA 12 construction.
9. Provide reduced voltage transformer for 115 volt control power.

F. Furnish control panels complete with the following features:
1. Control hoist motions by means of magnetic contactors supported on shockproof mountings.
2. Furnish magnetic main contactor for power circuit disconnect with control from emergency Start-Stop buttons in pushbutton station.
3. Provide under voltage protection.
4. Disconnect all motors on power failure.
5. Provide magnetic reversing type starters.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with the Drawings, shop drawings, and manufacturer's instruction.

B. Lubricate as required.

3.2 MANUFACTURER'S SERVICES

A. Provide manufacturer's services under provisions of Section 01445.

B. Minimum Service Requirements:
   1. Installation: As required for proper installation.
   2. Start-up and field testing: One half day onsite.
   3. Operator training: One half day onsite.

C. Service to Repair Defective Work: Provide during one-year warranty period under the provisions of General Conditions.

END OF SECTION

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SECTION 15000

PLANT PIPING - GENERAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building piping.

B. Yard piping.

C. This Section provides general piping requirements. The Detail Piping Specifications provide additional requirements.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
1. ANSI B1.20.1-83 - Pipe Threads, General Purpose (In.).
2. ANSI B16.1-75 - Cast Iron Pipe Flanges and Flanged Fittings.
3. ANSI B16.3-77 - Malleable Iron Threaded Fittings.
4. ANSI B16.4-77 - Cast Iron Threaded Fittings.
5. ANSI B16.5-81 - Pipe Flanges and Flanged Fittings.
6. ANSI B16.9-78 - Factory-Made Wrought Steel Buttwelding Fittings.
7. ANSI B16.12-83 - Cast Iron Threaded Drainage Fittings.
8. ANSI B16.14-77 - Ferrous Pipe Plugs, Bushings, and Lock Nuts with Pipe Threads.
9. ANSI B16.18-78 - Cast Copper Alloy Solder Joint Pressure Fittings.
10. ANSI B16.21-78 - Non-Metallic Flat Gaskets for Pipe Flanges.
11. ANSI B16.22-80 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
12. ANSI B16.39-77 - Malleable Iron Threaded Pipe Unions.
13. ANSI B31.1-83 - Power Piping.
14. ANSI B31.5-74 - Refrigeration Piping.

B. American Society for Testing and Materials (ASTM):
1. ASTM A47-77 - Specification for Malleable Iron Castings.
2. ASTM A53-82 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated and Seamless.
3. ASTM A74-82 - Specification for Cast Iron Soil Pipe and Fittings.
4. ASTM A106-82 - Specifications for Seamless Carbon Steel Pipe for High Temperature Service.
5. ASTM A120-82 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.
6. ASTM A135-79 - Specifications for Electric Resistance Welded Steel Pipe.
7. ASTM A183-80 - Specifications for Carbon Steel Track Bolts and Nuts.
8. ASTM A234-82A - Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

9. ASTM A333-82 - Specification for Seamless and Welded Steel Pipe for Low Temperature Service.
10. ASTM B32-76 - Specification for Solder Metal.
11. ASTM B88-83 - Specification for Seamless Copper Water Tube.
12. ASTM B280-83 - Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
13. ASTM D2104-74 - Specification for Polyethylene (PE) Plastic Pipe, Schedule 40.
14. ASTM 2310-80 - Classification for Machine-Made Reinforced Thermosetting Resin Pipe.
15. ASTM D2564-80 - Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
16. ASTM D2609-74 - Specification for Plastic Inset Fittings for Polyethylene (PE) Plastic Pipe.
17. ASTM D2665-82 - Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
18. ASTM D2729-80 - Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
19. ASTM D2737-83 - Specification for Poly (Vinyl Chloride) (PVC) Plastic Tubing.
20. ASTM D2740-80 - Specification for Poly (Vinyl Chloride) (PVC) Plastic Tubing
21. ASTM D3261-82 - Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Pipe and Tubing.
22. ASTM F402-80 - Practice for Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings.

C. Cast Iron Soil Pipe Institute (CISPI):
1. CISPI 301-82 - Standard Specification for Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Systems for Drain Waste or Vent, Sewer, Rain Water or Storm Drain Systems.
2. CISPI 310-82 - Specification for Cast Iron Soil Pipe Institute's Patented Joint for Use in Connection with Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rain Water or Storm Drain Systems.
3. CISPI HSN-78 - Specification for Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe Fittings.

D. American Society of Mechanical Engineers (ASME):
1. ASME Boiler and Pressure Vessel Code, Section II, Part C.
2. ASME Boiler and Pressure Vessel Code, Section IX.

1.3 PIPING SCHEDULE

A. The Piping Schedule in the Drawings lists each service by name and by legend, and tabulates the applicable Detail Piping Specification section numbers for each piping material to be used in a given service and location. In locations where the referenced specification for a service is unacceptable, due to unique or localized physical or chemical limitations, the specifications for an acceptable alternative material shall be submitted to the Engineer for approval.

B. The Detail Piping Specification section numbers are referenced also as to nominal pipe size, exposed or buried, submerged, concrete encased, test pressure, operating pressure, etc.

1.4 SUBMITTALS

A. Submit shop drawings under the provisions of Division 1. Submit pipe material and joint type for each pipeline.

B. Submit shop drawings under the provisions of Division 1 for all couplings, adapters, wall pipes, sleeves, sealants, dielectric fittings, hangers and supports.

C. Submit shop drawings under the provisions of Division 1 showing double-line drawings of each piping system, locating each support and hanger, identifying the type by catalog number or shop drawing detail number, and showing anchor locations and identifying them by shop drawing detail number. Show also all couplings, adapters, etc.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products under the provisions of Division 1.

PART 2 PRODUCTS

2.1 GENERAL

A. The materials to be used for the piping systems shown on the Drawings are listed by service in the Piping Schedule.

B. Like items of material shall be the end products of one manufacturer.

C. Paint and color code all exposed metal piping as specified in Section 09900, PAINTING and the Piping Schedule respectively. Label all exposed piping as specified herein.

D. No change in material or joint selection will be permitted after submittal of shop drawings and their final review by the Engineer.

2.2 PIPE JOINTS FOR EXPOSED PIPING

A. Provide flanged pipe joints on exposed piping 3-inches and larger except as shown otherwise. Grooved end pipe joints may be substituted for flange joints for piping 3 inches and larger except as noted otherwise.

B. Provide joints as specified in the Detail Piping Specifications for all pipe smaller than 3 inches.

C. Provide welded pipe joints where shown on the Drawings.

2.3 PIPE JOINTS FOR BURIED PIPING

A. Provide mechanical joint or push-on joint pipe ends on all buried ductile iron pipe.

B. Restrain by thrust blocks or by tie rods all elbows, tees, pipe plugs and valves or as specified in the Detail Piping Specifications.

C. Provide joints for other buried piping as specified in the Detail Piping Specifications.

2.4 BURIED PIPING EXPANSION PROVISION

A. Install buried piping to allow for thermal expansion due to differences between installation and operating temperatures.

2.5 BUILDING PIPING EXPANSION PROVISIONS

A. Provided flanged coupling adapters or bellows type flexible couplings at connections to equipment.

B. Installation of additional flexible couplings to facilitate piping installation is acceptable provided that the Contractor submits complete details describing location, pipe supports, and hydraulic thrust protection.

C. Acceptable types of flexible couplings and expansion joints are as follows:
   1. Metallic Piping Systems:
      a. Flexible Couplings:
         1) Steel pipe: Provide Dresser Style 38; Smith-Blair, Inc. Style 411; or equal.
         2) Ductile iron pipe: Provide Dresser Style 138; Smith-Blair, Inc. style 441; or equal, with zinc-plated bolts and nuts.
         3) Provide thrust ties as required and shown to sustain the force developed by 1-1/2 times the test pressure specified.
      b. Transition Couplings: Provide Dresser Style 62; Smith-Blair, Inc. 413; or equal transition couplings to connect pipes with small differences in outside diameter.
      c. Flanged Coupling Adapters:
         1) Ductile iron pipe: Provide Smith-Blair, Inc. Series 912; or Dresser Industries, Inc Style 128W; or equal
         2) Steel pipe: Provide Smith-Blair, Inc. Series 913; or Dresser Industries, Inc Style 128W; or equal.
         3) Provide thrust ties attached to the pipe with welding lugs or cast-in-place lugs where indicated. Anchor studs placed perpendicular to the longitudinal axis of the pipe are unacceptable.
         4) Provide adequate thrust protection to sustain the force developed by 1-1/2 times the test pressures specified.
      d. Bellows Type Flexible Couplings:
         1) Provide Mercer Style 500; Garlock Style 204; or equal, with single Hypalon bellows and filled arch.
         2) Provide flanged joints with steel retaining rings, rated for 125 psi maximum operating pressure and 180º F maximum operating temperature.
         3) Provide thrust ties as required and shown to sustain the force developed by 1-1/2 times the test pressure specified.

2. Nonmetallic Piping Systems:
   a. Flexible Couplings and Expansion Joints:
      1) Provide Peabody Dore' Style E-1608-A; Resistoflex No. R6904; or equal.
      2) Bellows: Teflon construction having two convolutions unless otherwise shown.
      3) Joints: ductile iron flanges, drilled 150 psi ANSI standard, and Monel reinforcing bands suitable for 100 psi working pressure at 100º F and for the traverse shown on the Drawings.
      4) Limit Bolts: provide as specified for adjacent piping and to sustain the force developed by 1-1/2 times the test pressures specified.

2.6 PIPING SUPPORT SYSTEMS

A. General:
1. Piping shall be supported, in general, as described here-in-after and as shown by the pipe support details on the Drawings. Manufacturers' catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Provide special support and hangers where standard catalog supports are inapplicable.
2. No attempt has been made to show pipe supports in most locations, either on the Drawings or in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the plant. Where pipe supports are specifically called out on the Drawings, the Contractor shall provide this type of support.
3. Where piping connects to equipment it shall be supported by a pipe support and not by the equipment.
4. Pipe support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus hydraulic thrust, and plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.
5. All buried and submerged piping supports, guides, anchor bolts, and fasteners, and those installed in wet wells, shall be Type 316 stainless steel.
6. Concrete anchors and anchor bolts shall be as specified in Section 05500.
7. All components of the piping support system shall be hot-dipped galvanized steel, except where stainless steel is specified.

B. Building Piping:
1. Horizontal piping shall be supported with adjustable swivel-ring, split-ring, or Clevis type hangers, Anvil International 104 or 260; Fee & Mason Figure 199 or 239; or equal.
2. Stacked horizontal runs of piping along walls shall be supported by a metal framing system attached to concrete insert channels as shown, Unistrut, Kin-Line, or equal. No pipe shall be supported from the pipe above it.
3. Pedestal pipe supports shall be adjustable, with stanchion, saddle, and anchoring flange as shown, Anvil International 264 or 259; Fee & Mason Figure 291 or 259; or equal.
4. Horizontal piping hanger support rods:

a. Attach to steel beams with I-clamps, to concrete with inserts or flanges with flush shells, and to wood not less than 2-1/2-inch thick with lag screws and angle clips.
b. Provide universal concrete inserts with a load rating greater than the hanger rods they support.

5. Vertical piping hangers and supports shall be channel and pipe straps manufactured by Unistrut, Kin-Line, or equal.
6. Piping supports for vertical piping passing through floor sleeves shall be hot-dipped galvanized steel riser clamps, Anvil International 261; Fee & Mason Figure 241 or 238; or equal.
7. All hangers, rods, clamps, protective shields, metal framing supports, and hanger accessories shall be hot-dipped galvanized unless otherwise noted on the Drawings.

2.7 JOINTS FOR DISSIMILAR PIPE

A. Buried pipe: Joints between dissimilar buried pipe shall be made with insulating couplings, Dresser Style 39, Smith-Blair, Inc. Style 416, or equal.

B. Joints between dissimilar exposed pipe:
1. Make with insulating flanges, couplings and unions of suitable pressure ratings for system working pressures.
2. Construction materials: Galvanically compatible with the piping to which attached.
3. Joints:
a. 2-inch and smaller: Screwed or solder-joint unions.
b. 2-1/2-inch and larger: Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts as distributed by Epco Sales, Inc. of Cleveland, OH.; Capitol Insulation Unions; or equal. Insulating couplings shall be Dresser Style 39; Smith-Blair, Inc. Style 416; or equal.

2.8 SERVICE AND OUTLET SADDLES

A. Ferrous Metal Piping:
1. Outlet Size:
a. 4- inch and smaller: Pipe service saddles for all ferrous metal piping except stainless steel shall be Smith-Blair, Inc., Series 313 or 366; Dresser, Style 91; or equal. Service saddles shall be capable of withstanding 150 psi internal pressure without leakage or overstressing. The run diameter shall be compatible with the outside diameter of the pipe on which the saddle is installed. Taps shall have iron pipe threads. Saddles shall have malleable or ductile iron bodies and galvanized steel straps, steel hex nuts and washers, and neoprene seals. Service saddles shall be of double-strap design. Service saddles shall not be used on glass lined ductile iron pipe, factory applied tapping bosses shall be used.
b. 6-inch and larger: Outlet saddles for ductile iron piping shall be from AMERICAN Ductile Iron, or US Pipe. Outlet saddles shall be rated 250 psi operating pressure, with outlet connections as shown on the drawings. Saddles shall have ductile iron bodies and galvanized steel straps, stainlees steel hex nuts and washers, and SBR rubber gaskets.

B. Plastic Pipe: Service saddles for PVC and CPVC pipe shall have solid polypropylene bodies with Buna-N seals and stainless steel worm drive clamps, or polypropylene threaded inserts with vinyl coated steel saddle bodies and Type 316 stainless steel bolts. Saddles shall be Smith-Blair, Inc., Style 315 or 317; Dresser, Style 194; or equal.

2.9 SLAB, FLOOR, WALL AND ROOF PENETRATIONS AND CLOSURES:

A. All piping penetrations of slabs, floors and walls shall be ductile iron wall pipes with integrally cast or fabricated welded seep rings unless shown otherwise on the Drawings. Verify size and location of all penetrations and place wall pipes before pouring concrete.

B. Ductile Iron Wall Pipes:

1. Provide ductile iron wall pipes of the proper diameter and with joints as shown on the Drawings or as required for connection. Wall pipes shall be a thickness equal to or greater than the remainder of the pipe in the line, and shall comply with the requirements for fittings in the applicable Detail Piping Specification. All wall pipes shall be provided with integrally cast or fabricated welded seep rings. Flanges and mechanical joint bells set flush with the face of walls shall be tapped for stud bolts.
2. Rubber-gasketed compression collars are unacceptable. The Contractor shall place early orders for wall pipes so they are available in sufficient time for placement in concrete forms. Coat wall pipes with System No. 2 as specified in Section 09900. Support wall pipes by formwork to prevent contact with reinforcing steel.

C. Pipe Sleeves:

1. All piping passing through concrete or masonry shall be installed through hot-dipped galvanized steel pipe or Century-Line high density polyethylene sleeves as manufactured by PSI/Thunderline Corporation; or equal. For fire rated rooms, provide hot-dipped galvanized wall sleeves only. Fabricate sleeves as shown on the detail drawings.
2. All sleeves in exterior or water-bearing walls shall have a center flange for water stoppage. The annular space between pipes and sleeves in exterior walls shall be watertight.
3. The annular space between pipes and sleeves in exterior walls shall be watertight. The joint shall be sealed by a modular mechanical unit shaped to continuously fill the annular space between the pipe and wall sleeve. The interconnected rubber links shall be assembled with 316 stainless steel bolts, nuts, and washers pressure plates shall be glass reinforced nylon. Tightening of the bolts shall cause the rubber sealing links to expand, resulting in a watertight seal between the pipe and wall sleeve opening. Closures shall be sized according to manufacturer's instructions for the size of pipes shown on the Drawings. Seals shall be Link-Seal as manufactured by PSI/Thunderline Corporation; or equal.
4. Fire rated pipe-through-wall penetrations shall be sealed be modular type interlocking synthetic rubber links shaped to continuously fill the annular space. Fire seals constructed of steel pressure plates and steel bolts, nuts, and washers and specially formulated fire resistant silicone rubber sealing elements (ASTM D2000 M1GE505). For 1 hour fire stop, use one belt of Link-Seal Model T (FM approved). For 3 hour fire stop, use 2 belts of Link-Seal Model FS. Seals shall be Link-Seal by PSI/Thunderline, or approved equal.

5. Coat steel pipe sleeves with System No. 2, as specified in Section 09900. Support sleeves from formwork to prevent contact with reinforcing steel.

D. Floor Pipes:

1. Provide ductile iron floor pipes with diameter as shown on the Drawings, or as required for connection. Floor pipes shall be a thickness equal to or greater than the remainder of the pipe in the line, and shall comply with the requirements for fittings in the applicable Detail Piping Specification. All floor pipes shall be provided with integrally cast or fabricated welded seep rings. Flanges shall be located a minimum of 6 inches above the top of floor.
2. The Contractor shall place early orders for floor pipes so they are available in sufficient time for placement in concrete forms. Coat floor pipes with System No. 2 as specified in Section 09900. Support floor pipes by formwork to prevent contact with reinforcing steel.

E. Floor Sleeves:

1. Provide hot-dipped galvanized steel pipe floor sleeves for all piping passing through concrete floors. Fabricate sleeves as shown on the detail drawings.
2. The annular space between pipes and sleeves in floors shall be watertight. The joint shall be sealed by a modular mechanical unit shaped to continuously fill the annular space between the pipe and floor sleeve. The interconnected rubber links shall be assembled with 316 stainless steel bolts, nuts, and washers pressure plates shall be glass reinforced nylon. Tightening of the bolts shall cause the rubber sealing links to expand, resulting in a watertight seal between the pipe and floor sleeve opening. Closures shall be sized according to manufacturer's instructions for the size of pipes shown on the Drawings. Seals shall be Link-Seal as manufactured by PSI/Thunderline Corporation; or equal.
3. Fire rated floor penetrations shall be sealed be modular type interlocking synthetic rubber links shaped to continuously fill the annular space. Fire seals constructed of steel pressure plates and steel bolts, nuts, and washers and specially formulated fire resistant silicone rubber sealing elements (ASTM D2000 M1GE505). For 1 hour fire stop, use one belt of Link-Seal Model T (FM approved). For 3 hour fire stop, use 2 belts of Link-Seal Model FS. Seals shall be Link-Seal by PSI/Thunderline, or approved equal.
4. Coat steel floor sleeves with System No. 2, as specified in Section 09900. Support sleeves from formwork to prevent contact with reinforcing steel.

2.10 FIRESTOPPING

A. For all pipes penetrating a fire rated room, provide hot-dipped galvanized wall sleeves and fill the void with Type II fire resistive caulk. Room fire rating is determined by the door type used, which is found in the Architectural Door Schedule.

B. Type II fire resistive caulk shall be 3M brand CP-25; or equal.

2.11 TAPE WRAP

A. Tape wrap shall be 15-mil butyl rubber adhesive, polyethylene-backed tape as manufactured by Polyken Division of the Kendall Company, Boston, MA; Royston Laboratories, Inc., Pittsburgh, PA; or equal.

2.12 HEAT SHRINK WRAP

A. Heat shrink wrap shall be a cross-linked polyolefin wrap or sleeve with a mastic sealant. Wrap or sleeves shall be Raychem WPC, TPS, flange seal, or equal. Wrap type shall be as recommended by the manufacturer for the specific joint.

2.13 TRACER WIRE

A. The tracing wire shall be Neptco Trace-Safe® water blocking tracer wire RT Series with 19 gauge conductor and 1800 pound strength minimum.

B. Tracer wire stations shall be Rhino TriView TracerPed™ with internal terminals.

2.14 HEAT TRACING

A. Provide heat tracing as specified in Division 16.

2.15 PIPING SPECIALTIES

A. Simplex Strainer: Strainers, 3 inches and smaller, for water service shall be iron body, Y-pattern, 125-pound rated, with screwed bronze or bolted iron cap. Screen shall be heavy-gauge stainless steel or monel, 30-mesh. Strainers shall be Crane No. 988-1/2; Mueller No. H-9330; or equal.

B. Flashing Sleeves: Flashing sleeves shall be installed wherever piping passes through concrete roof structures. Where piping passes through wood or metal deck roofs, provide a 4-pound lead flashing extending 8 inches from the pipe in all directions, extended up the pipe, and fitted with a double-threaded flashing for pipes 3 inches and smaller. Flashing shall turn down inside the pipe for 4-inch piping. Flashing sleeves shall be J. R. Smith Figure 1720; Josam No. 26400; or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Drawings do not attempt to show exact details of all piping, and no extra payment will be allowed for obstructions by work of other trades or local obstructions to the work under this Contract that require offsets. Where diagrams have been made to show piping connections, the Contractor is cautioned that these diagrams must not be used for obtaining material quantities. Changes in location of equipment or piping, advisable in the opinion of the Contractor, shall be submitted to the Engineer for approval before proceeding with the work. All measurements and dimensions shall be verified at the site. All equipment shall be adjusted and left in a condition satisfactory to the Engineer.

3.2 PIPE PREPARATION AND HANDLING

A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench. The interior and exterior protective coating shall be inspected, and all damaged areas patched in the field with

material similar to the original. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

B. Use proper implements, tools, and facilities for the safe and proper handling of the pipe. Carefully handle pipe in such a manner as to avoid any damage to the pipe. Do not drop pipe into trenches under any circumstances.

3.3 PREPARATION OF TRENCH

A. Line and Grade:
   1. Do not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness.
   2. Grade shall be established from batter boards set in or over the trench at maximum 25-foot intervals. A minimum of three sets of batter boards with string line shall be maintained ahead of pipe laying at all times. A laser instrument may be used in place of batter boards.
   3. Grade the bottom of the trench by hand to the line and grade to which the pipe is to be laid, with proper allowance for pipe thickness and for gravel bedding cushion when specified or indicated. Remove hard spots that would prevent a uniform thickness of bedding. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.

B. Bell (Joint) Holes: At the locations of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides where necessary to permit easy visual inspection of the entire joint.

C. Removal of Water: Provide and maintain ample means and devices at all times to remove and dispose of all water entering the trench during the process of pipe laying. The trench shall be kept dry until the pipe laying and jointing are completed. Remove water as specified in Division 1.

D. Prevent Water and Animals From Entering Pipe: When the pipe laying is not in progress, including the noon hours, the open ends of pipe shall be closed, and no water, animals, or foreign material shall be permitted to enter the pipe.

E. Pipe Cover: Minimum pipe cover shall be 6 feet unless otherwise indicated by Drawings or Detail Pipe Specifications.

F. Tracer Wire:
   1. Install with all buried non-metallic pipe, with ends terminating at grade in tracer wire stations.
   2. Provide tracer wire stations at ends of lines, at all drilling pit locations, and at distances less than 1,000 feet between tracer wire stations, and at all hydrants (located behind the hydrants) on water lines. Provide sufficient length for test station installation height of 4 feet above finished grade.

3. Perform continuity testing at each test station to demonstrate wire continuity after completion of pipe installation. Demonstration testing must be performed in the presence of the Engineer. Submit test report to document test results.
4. If continuity testing fails, Contractor shall find and repair tracer wire discontinuities in accordance with the manufacturer's instructions.

3.4 LAYING BURIED PIPE

A. All buried pipe shall be laid on the prepared granular base and bedded to ensure uniform bearing. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable. Joints shall be made as specified for the respective types. Take all precautions necessary to prevent uplift and floating of the pipe before backfilling. Pipe bedding, pipe zone, and trench backfill materials and workmanship shall be as specified in Division 2.

B. Provide all special tools, appliances and lubricants for jointing pipe. Joints shall be made in accordance with manufacturer's recommendations. Backfill adequately to assure that joints, once home, are held in place.

C. Provide concrete thrust blocks or galvanized steel thrust ties at all changes of direction, tees, pipe plugs and valves for buried piping with mechanical joints or push-on joints.

D. Where the pipe is connected to concrete structures, the connection shall be made as shown. If the connection is not shown, make connection such that a standard pipe joint or flexible coupling is located no more than 2 feet from the structure.

E. Connect dissimilar pipe materials by means of a flexible coupling specified under JOINTS FOR DISSIMILAR PIPE. Install couplings in strict accordance with the manufacturer's recommendations.

F. Use concrete closure collars only when approved by the Engineer, and only when standard rubber gasketed joints or flexible couplings are impractical. Before the closure collars are poured, wash the pipe to remove all loose material and soil from the surface on which the concrete will be placed. Wet concrete pipe thoroughly prior to pouring the collars. Wrap and securely fasten a light gauge of sheet metal or building felt around the pipe to insure that no concrete will enter the line. Place reinforcement as shown on the Drawings. Make entire collar in one pour using 3,000 psi concrete and extend a minimum of 12 inches on each side of the joint. The minimum thickness around the outside diameter of the pipe shall be 6 inches. No collar shall be poured in water. After the collars are poured and have taken their initial set, cure by covering with well-moistened earth.

3.5 INSTALLATION OF EXPOSED PIPING

A. Unless shown otherwise, piping shall be parallel to building lines. Hangers on adjacent piping shall be aligned where possible.

B. Unless noted otherwise on the Drawings, horizontal pipe support or hanger spacing and hanger rod sizing for steel and ductile iron pipe shall be as follows:

Pipe Size	Maximum Support Hanger Span	Minimum Rod Size Single Rod Hangers
1-inch and Smaller	6 feet	3/8-inch
1-1/4-inch thru 2-1/2-inch	8 feet	3/8-inch
3-inch and 4-inch	10 feet	1/2-inch
6-inch	12 feet	5/8-inch
8-inch	12 feet	3/4-inch
10-inch and 12-inch	14 feet	7/8-inch
14-inch and 16-inch	16 feet	1-inch
18-inch	16 feet	1-1/8
20-inch thru 24-inch	18-feet	1-1/4
30-inch and larger	As Shown on Drawings	

1. When supporting ductile iron pipe, locate hanger rods at all non-rigid joints and at each change of direction.
2. Hanger minimum rod size for copper pipe shall be the same as for steel pipe. Hanger span shall be 2 feet less per size than for steel pipe, with 1-inch and smaller supported every 5 feet or less.
3. Hanger rod sizing for plastic pipe shall be same as for steel pipe. Spacing of hangers shall be as recommended by the manufacturer for the flow temperature in the pipe.
4. Hanger rod sizing and support spacing for stainless steel pipe shall be as shown in the Detail Piping Specification.
5. Vertical sway bracing shall be provided where shown, or on 10-foot maximum centers.
6. All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas or bridge crane runs.

C. All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle the vertical centerline of pipes.

D. Unions shall be installed where required for piping or equipment installation, even though they are not shown on the Drawings.

E. Plastic flanges shall be bolted using a filler gasket at any joint with a raised face. The filler gasket shall bear the bolt load uniformly and remove the flange moment from that part of the flange protruding beyond the outer edge of the raised face.

F. Piping shall be installed without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.

3.6 VENTS AND DRAINS

A. Vent the high point and drain the low point of all exposed pipelines, whether shown on the Drawings or not, with 3/4-inch valves on those pipelines 2-1/2-inch and larger and 1/2-inch valves on those pipelines 2-inch and smaller. Valve types shall be as shown on the Drawings. Where valves do not appear in the Schedule for a service listed, Type V300 valves shall be used.

3.7 WALL PIPES AND PIPE SLEEVES

A. Verify the size and location of all building and structure penetrations before concrete is poured. Wall pipes and pipe sleeves embedded in concrete walls, floors, and slabs shall be embedded as specified in Division 3 and as shown. Support all pipes embedded in concrete walls, floors, and slabs with formwork to prevent contact with the reinforcing steel.

3.8 INSTALLATION OF FLEXIBLE COUPLINGS AND FLANGED COUPLING ADAPTERS, GROOVED JOINT COUPLINGS, AND SERVICE SADDLES

A. Before installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Workmen tightening bolts shall use torque-limiting wrenches.

3.9 INSTALLATION OF INSULATING FLANGES, COUPLINGS AND UNIONS

A. Install insulating flanges, couplings, or unions wherever copper and ferrous metal piping are connected, wherever dissimilar ferrous metal are connected, wherever submerged metallic piping is connected to unsubmerged piping, and where shown on the Drawings. Insulated joints connecting submerged piping to exposed piping shall be installed above maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged metallic piping shall be isolated from the concrete reinforcement.

3.10 TESTING

A. General: Conduct pressure and leakage tests on all newly installed pipelines. Furnish all necessary equipment and material and make all taps in the pipe, as required. The Engineer will monitor the tests. Test pressures and fluid medium shall be as specified in the Piping Schedule on the drawings.

B. Testing New Pipe That Connects To Existing Pipe: New pipelines that are to be connected to existing pipelines shall be tested by isolating the new pipe.

C. Buried Piping:

1. Conduct final acceptance tests on buried piping that is to be hydrostatically tested after the trench has been completely backfilled. The Contractor may, if field conditions permit, as determined by the Engineer, partially backfill the trench and leave the joints open for inspection and conduct an initial service leak test. The acceptance test shall not, however, be conducted until all backfilling has been completed.
2. Buried piping that is to be pneumatically tested or subjected only to an initial service leak test shall have all joints exposed for the acceptance test.

D. Exposed Piping:

1. Conduct the tests on exposed piping after the piping has been completely installed, including all supports, hangers, and anchors.

E. Hydrostatic Leak Tests:

1. Equipment - Furnish the following equipment for the hydrostatic tests:

Amount	Description
2	Graduated containers
2	Pressure gauges
1	Hydraulic force pump Suitable hose and suction pipe as required

2. Exposed Piping - Water shall be used as the hydrostatic test fluid unless otherwise specified. Test water shall be clean and shall be of such quality as to minimize corrosion of the materials in the piping system. Vents at all high points of the piping system shall be opened to purge air pockets while the piping system is filling. Venting during the filling of the system also may be provided by the loosening of flanges having a minimum of four bolts or by the use of equipment vents. All parts of the piping system shall be subjected to the test pressure specified in the Piping Schedule. The hydrostatic test pressure shall be continuously maintained for a minimum time of 30 minutes and for such additional time as may be necessary to conduct examinations for leakage. Examination for leakage shall be made at all joints and connections. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Correct any visible leakage.
3. Buried Piping:
   a. Some leakage is permissible from buried water and wastewater pressure lines. Consequently, the hydrostatic testing of these pipelines must be conducted in a different manner, as follows:
   b. Where any section of pipe is provided with concrete thrust blocking, do not make the pressure test until at least 5 days have elapsed after the thrust blocking is installed. If high-early cement is used for thrust blocking, the time may be reduced to 2 days. When testing cement-mortar lined piping, slowly fill the section of pipe to be tested with water and allow to stand for 24 hours under slight pressure to allow the cement-mortar lining to absorb water.

c. Expel all air from the piping system before testing and apply and maintain the specified test pressure by means of the hydraulic force pump. Valve off the piping system when the test pressure is reached and conduct the pressure test for 2 hours, reopening the isolation valve only as necessary to restore the test pressure. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately. This measurement represents the leakage, which is defined as the quantity of water necessary to maintain the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L \equiv \frac{ND(P)^{1/2}}{7400}$$

In the above formula:

L = allowable leakage, in gallons per hour.
N = number of joints in the length of pipe tested.
D = nominal diameter of pipe, in inches.
P = average test pressure during the leakage test, in pounds per square inch

d. Correct any leakage greater than the allowance determined under this formula.

F. Pneumatic Leak Tests:

1. Equipment - Furnish the following equipment for the pneumatic tests:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 percent of the required primary test pressure.
1	Calibrated test gauge.

2. Pneumatic testing shall be performed using accurately calibrated instruments and oil-free, dry air. Tests shall be performed only on exposed piping, but only after the piping has been completely installed, including all supports, hangers and anchors, and inspected for proper installation. All parts of the piping system shall be subjected to the test pressure specified in the Piping Schedule. The Contractor shall recognize the hazards associated with air testing and shall take all necessary precautions to protect test personnel and Owner's personnel. All piping to be ested shall be secured to prevent damage to adjacent piping and

equipment in the event of a joint failure. Any appurtenant instruments or devices that could be damaged by the test shall be removed from the piping or suitably isolated before applying the test. Before starting the test, the Contractor shall notify the Engineer.

3. A preliminary pneumatic test not to exceed 25 psig shall be applied to the piping system before final leak testing, as a means of locating major leaks. Examination for leakage, detected by soap bubbles, shall be made at all joints and connections. After all visible leaks have been corrected, the pressure in the system shall gradually be increased to not more than 1/2 of the test pressure, after which the pressure shall be increased in steps of approximately 1/10 of the test pressure until the required test pressure has been reached. The pneumatic test pressure shall be continuously maintained for a minimum time of 10 minutes and for such additional time as may be necessary to conduct a soap bubble examination for leakage. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage. Any visible leakage shall be corrected.

G. Initial Service Leak Tests:

1. Equipment: Equipment used for initial service leak testing may be the same as that specified under HYDROSTATIC and PNEUMATIC LEAK TESTS hereinbefore, or the pump or compressor connected to the piping system.
2. Procedure: The initial service leak test shall be performed by gradually bringing the piping system up to normal operating pressure and holding it at the normal operating pressure continuously for a minimum of 10 minutes. Examination for leakage shall be made at all joints and connections. Soap bubbles shall be used to detect leaks in pneumatically tested systems. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected.

H. Test Records: Records shall be made of each piping system installation during the test. These records shall include:

1. Date of test.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, to include such items as:
   a. Leaks (type, location).
   b. Repairs made on leaks.
6. Certification by Contractor and initialed acknowledgment by Engineer.

3.11 INTERIM CLEANING

A. Care shall be exercised during fabrication to prevent the accumulation of weld rod, weld spatter, pipe cuttings and filing, gravel, cleaning rags, etc. within piping sections. All piping shall be examined to assure removal of these and other foreign objects before assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the material being cleaned.

3.12 FINAL CLEANING

A. Following assembly and testing and before final acceptance, all pipelines installed under this section, except air lines and gas lines, shall be flushed with water and all accumulated construction debris and other foreign matter removed. Flushing velocities shall be a minimum of 2.5 feet per second. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the Engineer. Accumulated debris shall be removed through drains 2-inch and larger or by dropping spools and valves. Immediately following drainage of flushed lines, the piping shall be air dried with compressed air.

B. Air and gas piping shall be blown clean of loose debris with compressed air.

3.13 CORROSION PROTECTION OF ATMOSPHERIC EXPOSED PIPING ACCESSORIES

A. All atmospheric exposed surfaces of black and hot-dip galvanized steel, brass, copper and bronze piping components shall be painted in accordance with Section 09900, System No. 5 or System No. 6 as described in the Paint Application Schedule.

B. Pipe support systems, except galvanized or stainless steel components, shall be painted in accordance with Section 09900, System No. 5.

3.14 CORROSION PROTECTION FOR CARBON STEEL PIPE

A. Exterior Coating For Exposed, Steel Pipe, Including Galvanized Pipe: Shop prime and finish coats in accordance with Section 09900, System No. 5 or System No. 6 as required. For insulated piping, paint shall be applied before installation of insulation.

B. Interior Lining: Carbon steel piping that is to be lined with coal-tar epoxy, as noted in the Piping Schedule shown on the Drawings, shall be as specified in Section 09900, System No. 2. Carbon steel piping that is to be cement-lined as noted on the Piping Schedule shall be in accordance with AWWA C205. Lining shall be applied by the pipe supplier.

C. Exterior Protection For Buried, Submerged or Embedded Pipe and for all Hydrants: Buried steel shall be coated by hand taping with pipe tape. The pipe surface shall be solvent cleaned, SSPC-SP 1, and wire brushed, SSPC-SP 3, to remove all dirt and loose rust and mill scale, and immediately primed with the tape manufacturer's recommendations. The tape shall be spirally applied to the pipe with a 50 percent overlap minimum after the primer has thoroughly dried. Joints shall be tape wrapped or heat shrink-wrapped. Joints shall be completed above grade or a sufficient size bell hole excavated to permit joint wrapping without contamination. Tape wrapping and heat shrink-wrap are specified under PRODUCTS.

D. Exterior Protection for Buried or Submerged Piping Accessories: Exterior protection shall be in accordance with Section 09900, System No. 2.

3.15 CORROSION PROTECTION FOR COPPER PIPING

A. For Atmospheric Exposed Copper Pipe: Copper piping shall be painted in accordance with Section 09900, System No. 5 or System No. 6. Paint shall be applied before installation of insulation.

B. Exterior Coating For Buried Copper Pipe: All buried copper pipe shall be coated by hand taping with pipe tape. The pipe surface shall be solvent cleaned, SSPC-SP 1, and wire brushed, SSPC-SP 3, to remove all dirt and loose rust and mill scale, and immediately primed with the tape manufacturer's recommended primer in accordance with the manufacturer's recommendations. The tape shall be spirally applied to the pipe with a 50 percent overlap minimum after the primer has thoroughly dried. Joints shall be completed above grade or a sufficient size bell hole excavated to permit joint wrapping without contamination. Tape wrapping and heat shrink-wrap are specified under PRODUCTS.

3.16 CORROSION PROTECTION FOR DUCTILE IRON AND CAST IRON SOIL PIPE

A. For Atmospherically Exposed Ductile Iron: Exterior protection shall be in accordance with Section 09900, System No. 5 or System No. 6 as described in the Paint Application Schedule. NOTE: Ductile iron pipe for interior use shall be provided by the Mechanical Contractor without asphaltic or bitumastic exterior coatings. This requirement applies to all ductile iron pipe except buried pipe.

B. Cement Linings: As specified in the Detail Piping Specification.

C. Exterior Protection For Buried Pipe: Buried ductile iron piping shall be wrapped with polyethylene bagging, 8 mils minimum thickness, manufactured in accordance with the latest edition of ASTM D 1248, Type I, Class C, Grade E1 and installed in accordance with ANSI A21.5/AWWA C105 and the manufacturer's recommendations.

3.17 PIPE PAINTING AND IDENTIFICATION

A. Painting of piping systems shall be as specified in Section 09900, and in accordance with the Piping Schedule.

B. Mechanical pipe identification shall be as specified in Section 15190.

END OF SECTION

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SECTION 15004

DETAIL PIPING SPECIFICATION - CEMENT-LINED
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cement-lined ductile iron pipe.

B. Grey cast iron or ductile iron fittings.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General.
   1. See referenced section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

PART 2 PRODUCTS

2.1 PIPE

A. General Pipe Requirements: Centrifugally cast, Grade 60-42-10 iron, ANSI/AWWA C151/A21.51, cement-lined and seal-coated in accordance with ANSI/AWWA C104/A21.4, 250 psi minimum working pressure.

B. Buried pipe Requirements: Minimum thickness Class 53 as specified in ANSI/AWWA C151/A21.51, Tables 51.4 and 51.5.

C. Requirements for specific types of pipes:
   1. Exposed Flanged Pipe: Minimum thickness class 53 as specified in ANSI/AWWA C115/A21.15, Table 15.1.
   2. Grooved End Pipe 3-inches and larger:
      a. Conform to AWWA C606 rigid radius cut grooved pipe on all exposed piping unless otherwise noted.
      b. Conform to AWWA C606 for all flexible radius cut grooved pipe as noted.
      c. Conform to the following minimum Thicknesses Classes:
         1) 3 to 16 inch piping: Class 53.
         2) 18 inch piping: Class 54.
         3) 20 inch piping: Class 55.
         4) 24 inch piping and larger: Class 56.
   3. Mechanical Pipe: Conforming to the requirements of ANSI/AWWA C111/A21.11.

4. Push-On: Conforming the requirements of ANSI/AWWA C111/A21.11.

2.2 JOINTS

A. Flanged, grooved end, mechanical joint, or push-on as specified in Section 15000.

B. Refer to the pipe schedule in the Drawings for specific joint type required for some services.

C. Provide fittings and all coupling components from the same manufacturer to assure uniformity and compatibility of grooved end piping components.

D. Provide joint restraint as follows:
1. At all elbows (except 90° elbows) and all joints within 20 feet of all elbows.
2. At all 90° elbows and all joints within 40 feet of all 90° elbows.

E. Accomplish joint restraint by using push-on joint restraint gaskets from American Ductile Iron Pipe Fast-Grip gasket of U.S. Pipe Field Lok gasket, or equal, or mechanical joints with multiple wedge retainer glands, EBAA Iron Sales MEG-A-LUG series 1100, or approved equal.

2.3 FITTINGS

A. General Construction: Gray or ductile iron, 150 psi minimum working pressure, cement-lined and seal-coated.

B. Provide tapping bosses on fittings where taps are shown.

C. Requirements for specific types of fittings:
1. Flanged: ANSI/AWWA C110/A21.10 and ANSI B16.1, faced and drilled 125-pound ANSI standard.
2. Grooved End: ANSI/AWWA C110/A21.10, ANSI/AWWA C606, and ANSI B16.1, radius cut grooved, rigid joint, as manufactured by Victaulic, Gustin-Bacon, or equal.
3. Mechanical Joint: Full body mechanical joint fittings meeting ANSI/AWWA C110/A21.10 with the joint meeting the requirements of ANSI/AWWA C111/A21.11.
4. Push-On: ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53, American Ductile Iron Pipe, Fastite Joint; or U.S. Pipe and Foundry, Tyton Joint, or equal.

D. Compact ductile iron mechanical joint fittings, ANSI/AWWA C153/A21.53, Clow Corporation or equal, may be substituted for the mechanical joint fittings specified above.

2.4 FLANGES

A. ANSI A21.15/AWWA C115, thread on flanges with 250 psi working pressure and ANSI 125-pound drilling.

B. Grooved end pipe adaptor flanges shall be malleable iron, ASTM A 47, or ductile iron, ASTM A 536, Victaulic Style 31, Gustin-Bacon, or equal.

2.5 COUPLINGS

A. Grooved end pipe couplings shall be malleable iron, ASTM A47, or ductile iron, ASTM A536, Victaulic Style 31, Gustin-Bacon, or equal.

2.6 BOLTS & NUTS

A. Flanged: Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts. Size, length, and number as shown in AWWA C110 and AWWA C115.

B. Mechanical Joint: In accordance with ANSI/AWWA C111/A21.11 in stainless steel 304, t-bolts per ASTM F593 and heavy hex nuts per ASTM F594

C. Grooved End: Manufacturer's standard.

2.7 GASKETS

A. Mechanical or Push-on Joints: Natural rubber (styrene butadiene copolymer) conforming to ANSI/AWWA C111/ A21.11.

B. Flanged Joints:
   1. Provide 1/8-inch thick, cloth-inserted natural rubber (styrene butadiene copolymer) conforming to applicable parts of ANSI B16.21 and AWWA C207.
   2. Gasket material: Suitable for use in sewage or potable waterlines and free from corrosive alkali or acid ingredients.
   3. Gasket type:
      a. Full-face type for 125-pound FF flanges and 250-pound FF flanges up to 12-inches in diameter.
      b. For sizes 14-inches and greater, use ring gaskets.

C. Grooved End Joints:
   1. Provide manufacturer's flush-seal type specifically designed for cast surfaces.
   2. Properties: As designated in ASTM D 2000 for the required service.
   3. Dimensions: Conforming to AWWA C 606.

2.8 LUBRICANT

A. Provide manufacturer's standard lubricant for push-on or mechanical joint piping.

PART 3 EXECUTION

3.1 HANDLING PIPE

A. Care shall be taken not to damage the cement lining when handling the pipe.

3.2 CUTTING PIPE

A. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.

3.3 DRESSING CUT ENDS

A. Dress cut ends of pipe in accordance with the type of joint to be made.

B. Dress cut ends of mechanical joint pipe to remove sharp edges or projections which may damage the rubber gasket.

C. Dress cut ends of push-on joint pipe by beveling, as recommended by the pipe manufacturer.

D. Dress cut ends of pipe for flexible couplings, flanged coupling adapters, and grooved end pipe couplings as recommended by the coupling or adaptor manufacturer.

3.4 FABRICATION OF FLANGED PIPE

A. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the jobsite with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

B. Flanges shall be faced after fabrication in accordance with ANSI A21.15/AWWA C115.

3.5 JOINTING PIPE

A. Flanged:
   1. Thoroughly clean all oil, grease, and foreign material from the faces of the flanges before connecting flanged pipe.
   2. Check all rubber gaskets for proper fit and cleanliness.
   3. Take care to assure proper seating of the flange gasket.
   4. Tighten bolts so that the pressure on the gasket is uniform.
   5. Use torque-limiting wrenches to ensure uniform bearing insofar as possible.
   6. Removed and reset gasket and retighten bolts at joints that leak during retightening.

B. Grooved end:
   1. Install in accordance with the manufacturers printed instructions.
   2. Clean ends, coupling, and gasket before assembly.

C. Mechanical and Push-On Joint:
   1. Join pipe with mechanical or push-on type joints in accordance with the manufacturer's recommendations.
   2. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation.
   3. Furnished pipe manufacturer's gasket lubricant. No substitute lubricants will be permitted.

4. Install mechanical joints in accordance with the instructions in ANSI/AWWA C600 and ANSI/AWWA C111/A21.11.

3.6 TESTING

A. All lines shall be tested as listed in the Pipe Schedule shown on the Drawings.

B. Follow the testing procedures specified in Section 15000.

3.7 CORROSION PROTECTION

A. As specified in Section 15000.

3.8 SUPPORTS AND HANGERS

A. As specified in Section 15000.

3.9 GENERAL INSTALLATION OF EXPOSED PIPING

A. As specified in Section 15000.

END OF SECTION

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SECTION 15008

DETAIL PIPING SPECIFICATION - MILL TYPE
STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mill type steel pipe and malleable iron fittings.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General: See referenced Section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

B. Welding procedures and qualifications.

C. Submit review procedure specifications and qualifications records of welding procedures for all pipe welding to be performed under this section, in accordance with Section IX, Article II of the ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.1 PIPE

A. General Pipe Requirements:
   1. Piping 1½-inch and smaller: ASTM A 106, Grade B.
   2. Piping 2-inch and larger: Carbon steel, black, seamless or electric resistance welded, ASTM A 53, Grade B.

B. Screwed, Butt-Welded, and Flanged Pipe:
   1. 2-inch and Smaller: Schedule 40.
   2. 2-1/2-inch through 6-inch: Schedule 40.
   3. 8-inch through 12-inch: Schedule 20.
   4. 14-inch through 24-inch: Schedule 10.

C. Grooved End Pipe:
   1. 2-1/2-inch through 6-inch: Schedule 40.
   2. 8-inch through 14-inch: Schedule 30.

2.2 JOINTS

A. Requirements for Specific Types of Joints:

1. 2-inch and Smaller: Screwed.
2. 2½-inch to 14-inch: Grooved end conforming to AWWA C606, Butt-welded, or flanged, unless other- wise shown.
3. Larger than 14-inch: Butt-welded or flanged unless otherwise shown.
4. Do not use grooved end joints for natural gas (G) or low pressure air piping (ALP).

B. Refer to the pipe schedule in the Drawings for specific joint type required for some services.

2.3 FITTINGS

A. 2-Inch and Smaller:
1. General requirements: Screwed, 150-pound malleable iron, black, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3.
2. Standard union requirements: 300-pound malleable iron, black, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3, brass to iron seat.
3. Unions for natural gas: 3,000 pound, forged carbon steel, ASTM A105, steel seats.

B. 2½-Inch Through 14-Inch:
1. Grooved End: Malleable iron, ASTM A47, or ductile iron, ASTM A536, grooved or shouldered ends to accept mechanical couplings without field preparation, Victaulic, Gustin-Bacon, or equal.
2. Butt Welding Type: Carbon steel, to match pipe wall thickness, ASTM A234, Grade WPB, conforming to ANSI B16.9 standards.

C. Larger than 14-inch: Butt-welded carbon steel, to match pipe wall thickness, ASTM A 234, Grade WPB, conforming to ANSI B16.9 standards.

2.4 BRANCH CONNECTIONS

A. 2-Inch and Smaller: Screwed tees as specified under FITTINGS, or 3000-pound WOG forged carbon steel, ASTM A105, Grade II commercial welding branch fittings with threaded outlet, as manufactured by Bonney Forge Division, Gulf and Western Industrial Products Company, Allentown, PA; Allied Piping Products Co., Inc., Norristown, PA; or equal.

B. 2½-Inch and Larger: Tees or reducing tees as specified under FITTINGS; to match pipe wall, cast steel, ASTM A216, Grade WCA, or 3000-pound WOG forged carbon steel, ASTM A105, Grade II commercial welding branch fittings with butt-welding outlet, as manufactured by Bonney Forge Division, Gulf and Western Industrial Products Company, Allentown, PA; Allied Piping Products Co., Inc., Norristown, PA; or equal; or fabricate from pipe. Use tee for branch outlet full size of run or one size reduced.

2.5 FLANGES

A. Forged steel, ASTM A 181 Grade I, slip-on or welding neck type, faced and drilled 150-pound, 1/16-inch raised face, ANSI B16.5 standard, or AWWA C207, Class D hub type, faced and drilled 125-pound flat-face, ANSI B16.1 standard.

B. Grooved End Pipe Adapter Flanges: Provide malleable iron, ASTM A47, conforming to Federal Specification QQ-I-666C, Grade II, or ductile iron, ASTM A536, Victaulic, Gustin-Bacon, or equal. When matching equipment with 250-lb or 300-lb RF flanges, use forged steel, ASTM A181, Grade I welding neck type, faced and drilled 300-lb, 1/16-inch raised face ANSI Standard.

C. Use welding neck flanges when abutting butt-weld fittings. Match Welding neck bore pipe ID.

D. Machine off the raised face of a steel flange when mating with a cast iron flat faced flange.

2.6 COUPLINGS

A. Grooved end pipe couplings shall be malleable iron, ASTM A 47, conforming to Federal Specification QQ-I-666C, Grade II, or ductile iron, ASTM A 536, Victaulic Style 75, Gustin-Bacon, or equal.

B. Screwed pipe couplings shall be malleable iron, ASTM A 197 or ASTM A 47, dimensions conforming to ANSI B16.3. Couplings for use on natural gas, propane, nitrogen, fuel oil or lubricating grease shall be 3000-pound, forged carbon steel, ASTM A 105.

2.7 BOLTING

A. For Grooved End Joints: Heat-treated carbon steel, ASTM A183 bolts and nuts, minimum tensile 110,000 psi.

B. 150-pound RF Flanges: Carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.

C. 125-pound FF AWWA Flanges: Carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.

D. When mating flange on equipment is cast iron and gasket is flat ring type, use ASTM A307, Grade B, square head bolts and heavy hex head nuts.

E. When 1/8-inch undersize bolting material is used for steel insulating flanges, use ASTM A193, Grade B7 alloy stud bolts and ASTM A194, Grade 2H carbon steel heavy hex nuts.

2.8 GASKETS

A. For Grooved End Joints: EPDM or Chlorinated butyl with properties conforming to ASTM D 2000, dimensions to AWWA C606.

B. For Flanged Joints: Unless otherwise specified, 1/16-inch flat ring type, Garlock 2900, or equal.

2.9 THREAD LUBRICANT

A. Teflon tape.

2.10 COVERED WELDING ELECTRODES

A. AWS A5.1, E6010 for shielded metal-arc process.

2.11 WELDING ROD AND BAR ELECTRODES

A. As specified in PROCEDURE QUALIFICATIONS.

PART 3 EXECUTION

3.1 WELDING

A. In accordance with latest editions of Section IX, ASME Boiler and Pressure Vessel Code and the American national Standard Code for Pressure Piping, ANSI B31.3.WELDING PERFORMANCE QUALIFICATION

B. Qualify all welders and welding operators at the Contractor's sole expense by a qualified testing laboratory before performing any welding under this section.

C. Qualification tests: Perform qualification tests in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.

D. Qualify welders and operators for making groove welds in carbon steel pipe in positions 6G for each welding process to be used.

E. Qualification tests may be waived if evidence of prior qualification is deemed suitable by the Engineer.

F. Retest any welders at any time Engineer considers the quality of the welder's work substandard.

3.2 FABRICATION

A. End Preparation:
   1. Prepared Pipe edges preferably by machine shaping.
   2. Oxygen or arc cutting are acceptable only if the cut is reasonably smooth and true and all slag is removed either by chipping or grinding.
   3. Bevel ends for butt welding to conform to ANSI B16.25.

B. Cleaning: Surfaces shall be clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.

C. Alignment and Spacing: Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness. Root opening of the joint shall be as stated in the procedure specification.

D. Procedure:

1. Field welding: Use the shielded metal-arc process.
2. Shop fabrication: Fabricate in accordance with the submitted welding procedure qualifications.
3. Perform no welding if there is impingement of any rain, snow, sleet, or high wind on the weld area or if the ambient temperature is below 32° F.
4. If the ambient temperature is less than 32° F preheat the work to a temperature that is warm to the touch of a hand.
5. Tack welds:
   a. Perform tack welds by a qualified welder using the same procedure as for the completed weld.
   b. Completely removed tack welds that have cracked or do not match the requirements of the completed weld.
   c. Make tack welds that are not to be removed with an electrode that is the same as or equivalent to the electrode to be used for the first weld pass.
6. Thoroughly clean each layer of deposited weld metal before the deposition of each additional layer of weld metal, including the final pass, with a power-driven wire brush.
7. Chip or grind out surface defects that will affect the soundness of weld.
8. On pipe sizes 6-inch through 24-inch, make a minimum of three weld passes using the specified covered electrode.
9. On all welded pipe 4-inch and under, make a minimum of a full root and second pass weld.
10. Finished welds: Free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity, slag inclusions, and other defects in excess of the limits prescribed in Chapter V of ANSI B31.3.
11. Branch connections: Fit and groove-welded in accordance with the details described and shown in Chapter V of ANSI B31.3.

3.3 TESTING

A. Hydrostatically or pneumatically test all lines at the pressures listed in the Piping Schedule.

B. Follow procedures as specified in Section 15000.

3.4 SUPPORTS AND HANGERS

A. As specified in Section 15000.

3.5 CORROSION PROTECTION

A. As specified in Section 15000.

3.6 GENERAL INSTALLATION OF EXPOSED PIPING

A. As specified in Section 15000.

END OF SECTION

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SECTION 15014

DETAIL PIPING SPECIFICATION – STAINLESS STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stainless steel pipe and fittings.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General: See referenced Section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

B. Welding procedures and qualifications.

PART 2 PRODUCTS

2.1 PIPE

A. Stainless steel, pickled and passivated, ASTM A 312 and ASTM A 778, Type 304L "as welded" grade, unless otherwise specified hereinafter.
   1. 2-inch and smaller: Schedule 40, seamless.
   2. 2-1/2-inch thru 8-inch: Schedule 10.
   3. 10-inch thru 30-inch: Schedule 5.

2.2 JOINTS

A. 2-Inch and Smaller: Screwed.

B. 2-1/2-inch and Larger: Butt welded or flanged.

2.3 FITTINGS

A. 2-Inch and Smaller: Screwed, stainless steel, 150-pound, rated 1,000-pound CWP forgings conforming to ASTM A 182, Type 304L, dimensions conforming to ANSI B16.3.

B. 2-1/2-Inch and Larger: Butt welding type, stainless steel, pickled and passivated, schedule to match piping, ASTM A 774, Type 304L, conforming to MSS SP-43; "as welded" grade; all ells LR, unless otherwise designated.

2.4 BRANCH CONNECTIONS

A. 2-Inch and Smaller: Screwed tees as specified under FITTINGS, or 3,000-pound WOG forged stainless steel, ASTM A 182, Type 304L commercial welding branch fittings with threaded outlet, as manufactured by Bonney Forge Division, Gulf and Western Industrial Division, Allentown, PA; Allied Piping Products Co., Inc., Norristown, PA; or equal.

B. 2-1/2-Inch and Larger: Tees or reducing tees as specified under FITTINGS or fabricate from pipe.

2.5 FLANGES

A. Forged stainless steel, ASTM A 182, Type 304L, slip-on type, faced and drilled 150-pound, 1/16-inch raised face, ANSI B16.5 standard.

2.6 FACE RINGS

A. Stainless steel, ASTM A 240, Type 304L, ID drilled 1/16-inch larger than pipe OD. Thickness shall suit pipe wall thickness and welding procedure to avoid warpage.

2.7 BOLTING

A. Type 316 stainless, ASTM A 193, Grade B8M hex head bolts and ASTM A 194, Grade 8M hex head nuts.

2.8 GASKETS

A. Unless otherwise specified, 1/16-inch flat ring type, Garlock 2900, or equal.

2.9 THREAD LUBRICANT

A. Teflon tape.

2.10 COVERED WELDING ELECTRODES FOR SHIELDED METAL ARCPROCESS

A. For Type 304L Pipe: AWS 5.4, E 308L.

2.11 WELDING ROD AND BARE ELECTRODES FOR GAS TUNGSTEN ARC OR GAS METAL ARC PROCESSES

A. For Type 304L Pipe: AWS 5.9, ER 308L.

PART 3 EXECUTION

3.1 WELDING

A. In accordance with latest editions of Section IX, ASME Boiler and Pressure Vessel Code and the American National Standard Code for Pressure Piping, ANSI B31.2 and B31.3 as applicable.

3.2 WELDING PROCEDURE QUALIFICATIONS

A. Furnish Engineer for prior review the procedure specifications and qualifications records of welding procedures for all pipe welding to be performed under this section, in accordance with Section IX, Article II of the ASME Boiler and Pressure Vessel Code.

3.3 WELDING PERFORMANCE QUALIFICATION

A. All welders and welding operators shall be qualified at the Contractor's sole expense by a qualified testing laboratory before performing any welding under this section. Qualification tests shall be in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code. Welders and operators shall be qualified for making groove welds in Types 304, 304L, 316, and 316L stainless steel pipe in position 6G for each welding process to be used.

B. Before the start of the work, Contractor shall submit a list of the welders he proposes using and the type of welding for which each has been qualified.

C. Qualification tests may be waived if evidence of prior qualification is deemed suitable by the Engineer. Contractor shall retest any welders at any time Engineer considers the quality of the welder's work substandard.

3.4 FABRICATION

A. End Preparation: Pipe edges shall be prepared preferably by machine shaping or cutting with an aluminum oxide blade. Oxygen or arc cutting are acceptable only if the cut is reasonably smooth and true and all slag is removed either by chipping or grinding. Beveled ends for butt-welding shall conform to ANSI B16.25.

B. Cleaning: Surfaces shall be clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding. Before welding, wire brush joints to be welded with stainless steel wire brushes or stainless steel wool.

C. Alignment and Spacing: Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness. Root opening of the joint shall be as stated in the procedure specification.

D. Procedure:

1. The direct current, reverse polarity, shielded metal arc or gas metal arc processes or direct current, straight polarity, gas tungsten-arc process shall be used for all field welding. Shop fabrication shall be in accordance with the submitted welding procedure qualifications. No welding shall be performed if there is impingement of any rain, snow, sleet, or high wind on the weld area, or if the ambient temperature is below 32º F. If the ambient is less than 32 º F, local preheating to a temperature warm to the hand is required.
2. Tack welds shall be thoroughly cleaned to avoid porosity or pinholing in the cover pass and shall be small enough to be readily fused into the succeeding bead. Tack welds, if not made by a qualified welder using the same procedure as for the completed weld, shall be completely removed. Tack welds which are not removed shall be made with an electrode that is the same as or equivalent to the

electrode to be used for the first weld pass. Tack welds which have cracked shall be removed.

3. Each layer of deposited weld metal shall be thoroughly cleaned before the deposition of each additional layer of weld metal, including the final pass, with a power-driven stainless steel wire brush. Surface defects that will affect the soundness of weld shall be chipped out or ground out.
4. Welds shall be free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity, slag inclusions, and other defects in excess of the limits prescribed in Chapter V of ANSI B31.3 as applicable.
5. Branch connections shall be fitted and groove-welded in accordance with the details described and shown in Chapter V of ANSI B31.3 as applicable.

3.5 TESTING

A. All lines shall be hydrostatically or pneumatically tested at the pressures listed in the Piping Schedule. Procedures shall be as specified in Section 15000.

3.6 SUPPORTS AND HANGERS

A. All hanger-pipe contact surfaces shall have a dielectric barrier. Hangers shall be as specified in Section 15000, except spacing shall be as follows:

Pipe Size	Maximum Support/Hanger Span	Minimum Rod Size Single Rod Hanger
1-1/2-inch and Smaller	6 feet	3/8-inch
2-inch thru 6-inch	8 feet	1/2-inch
8-inch thru 12-inch	10 feet	5/8-inch
14-inch and 16-inch	12 feet	3/4-inch
18-inch and 20-inch	14 feet	7/8-inch
24-inch	14 feet	1-inch
30-inch	17 feet	See Drawings

B. The load rating of universal concrete inserts shall not be less than that of the hanger rods they support.

3.7 CORROSION PROTECTION

A. As specified in Section 15000.

END OF SECTION

SECTION 15021

DETAIL PIPING SPECIFICATION –
PVC BELL AND SPIGOT PRESSURE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. PVC pressure pipe, 6 inch through 48 inch, with bell and spigot joints.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General: See referenced Section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

PART 2 PRODUCTS

2.1 POLYVINYL CHLORIDE WATER PIPE (PVC)

A. Requirements:
   1. 14-inch through 48-inch:
      a. Polyvinyl Chloride (PVC) pressure pipe meeting the requirements of AWWA Standard C-905, DR-25, with cast iron O.D. and integral elastomeric bell and spigot joints.
   2. 6-inch through 12-inch:
      a. Polyvinyl Chloride (PVC) pressure pipe meeting the requirements of AWWA Standard,C-900, DR-25, with cast iron O.D. and integral elastomeric bell and spigot joints.

B. Markings: Pipe shall bear external markings displaying nominal pipe size, pipe material, SDR number, AWWA designation.

2.2 JOINTS

A. Joints shall be bell and spigot. Spigot pipe ends shall be factory supplied with bevels. The bell shall consist of an integral wall section with a solid cross section elastomeric ring, and shall be as hydrostatically strong as the pipe wall.
   1. Elastomeric rings shall be factory installed butyl or hypalon rubber gaskets conforming to ASTM F477, "Elastomeric Seals (gaskets) for Joining Plastic Pipe".

B. Joint restraint shall be provided by use of Megalug restrained joints Series 2000PV or Series 2500 for C-900 PVC and C-905 PVC pipe.

C. Joint restraint shall be provided in the following locations:
   1. At all elbows (except 90º elbows) and all joints within 20 feet of all elbows.
   2. At all 90º elbows and all joints within 40 feet of all 90º elbows.

2.3 FITTINGS

A. Fittings shall be of ductile iron or PVC construction:
   1. Ductile iron:
      a. Push-on or mechanical, 350 psi minimum working pressure, cement-lined and seal-coated. Conforming to ANSI A21.10, AWWA C110 and ANSI A21.11, AWWA C111.
      b. American Ductile Iron Pipe, U.S. Pipe and Foundry, or equal, or compact fittings ANSI A21.53, AWWA C153, U.S. Pipe and Foundry, Clow Corporation, or equal.
      c. All fittings shall be wrapped with polyethylene encasement in accordance with ANSI/AWWA C105.
   2. PVC:
      a. Fabricated PVC fittings, DR-25, conforming to AWWA C900 and C905. Fittings shall have a dimensional ratio equal to that of the pipe they are being installed on. Fittings shall incorporate integral elastomeric gasket bell joints.
      b. All bends shall be constructed from a single section of PVC pipe, without joints, bonding or fiberglass-reinforced polyester wrapping. Other fabricated fittings shall be manufactured from segments of PVC pipe bonded together and over wrapped with fiberglass-reinforced polyester.

B. Fittings to be included as part of pipe cost.

2.4 BOLTS & NUTS

A. Mechanical Joint: In accordance with ANSI/AWWA C111/A21.11. in stainless steel 304, t-bolts per ASTM F593 and heavy hex nuts per ASTM F594

2.5 LUBRICANT

A. Provide manufacturer's standard for pipe and gasket materials. Do not substitute any other material for manufacturer’s joint lubricant.

2.6 TRACING WIRE

A. The tracing wire shall be Neptco Trace-Safe® Sewer blocking tracer wire RT 1803W (Green) with 19 gauge conductor and 1800 pound strength minimum.

2.7 PREPARATION AT THE PLANT FOR SHIPMENT

A. All pipe and couplings shall, unless otherwise specified, be prepared for standard commercial shipment.

PART 3 EXECUTION

3.1 HANDLING PIPE

A. Handle pipe in accordance with manufacturer's instructions. Do not handle pipe with chains or cables. Do not drop pipe.

3.2 CUTTING PIPE

A. Saw cut pipe in accordance with manufacturer's instructions. All cuts to be square, perpendicular to pipe axis, within tolerance of joints.

3.3 DRESSING CUT ENDS

A. Dress cut ends of pipe in accordance with the type of joint to be made.

B. Dress cut ends of mechanical joint pipe to remove sharp edges or projections that may damage the rubber gasket.

C. Dress cut ends of push-on joint pipe by leveling, as recommended by the pipe manufacturer.

3.4 JOINTING PIPE

A. Join pipe in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstances.

3.5 TESTING

A. All lines shall be tested as listed in the Pipe Schedule shown on the Drawings. Test procedures shall be as specified in Section 15000.

END OF SECTION

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SECTION 15100

VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Valve operators.

B. T-handled operating wrenches.

C. Valve boxes and extension stems.

D. Floor boxes and extension stems.

E. Chain wheels and guides.

F. Valve tagging requirements.

G. Globe valves.

H. Ball valves.

I. Plug valves.

J. Check valves.

K. Special valves.

L. Power operated valves.

1.2 SUBMITTALS

A. Submit shop drawings under the provisions of Division 1:
   1. Identify all submittal data with specified valve type number.
   2. Submit a valve schedule, identifying all valves by type number, pipeline, location, joint type, manufacturer and model or catalog number.
   3. Include all valves in a single submittal package. Partial or incomplete submittals will not be reviewed.

B. Submit operations and maintenance manual under the provisions of Section 01730.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle valves under the provision of Division 1.

PART 2 PRODUCTS

2.1 GENERAL

A. Like items of equipment shall be the end product of one manufacturer.

B. All valves shall be complete with all necessary operating handwheels, chain wheels, extension stems, worm and gear operators, operating nuts, chains, wrenches, and other accessories that are required for the proper completion of the work included under this section.

C. Valves shall be suitable for the intended service. Renewable parts including discs, packing, and seats shall be of types recommended by valve manufacturer for intended service.

D. Unless otherwise shown, valves shall be the same size as the adjoining pipe.

E. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters.

F. For the purpose of designating the type and grade of valve desired, a manufacturer's name and list or figure number is given in the following specifications. Valves of equal quality by other manufacturers will be considered in accordance with Division 1.

2.2 VALVE TYPES

A. Valve types are specified by number. The type of valve to be used for each service and application is indicated on the Drawings by valve number call out. Note that this is a general valve specification so that some of the valve types listed herein may not be a part of the Work.

2.3 DESIGN FEATURES

A. Brass and Bronze Components:
   1. Brass and bronze components of valves and appurtenances that have surfaces in contact with the water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.
   2. Approved alloys are of the following ASTM designations:
      a. B61, B62, B98 (Alloy A, B, or D), B139 (Alloy A, B143 (Alloy 1-B), B164, B194, B292 (Alloy A), B127, and B584 (Alloy 844).
      b. Stainless steel Alloy 18-8 may be substituted for bronze at the option of the manufacturer and with the approval of the Engineer.
   3. All gland bolts on iron body valves shall be bronze and shall be fitted with brass nuts.

2.4 VALVE OPERATORS

A. Equip all valves with handwheel operators, which open by turning counter-clockwise, unless otherwise shown or specified.

B. Proportion valve operator as to permit operation of the valve under full operating head with a maximum pull of 80 pounds on the handwheel or crank.

C. Worm and Gear Operators for Manually Operated Valves:
   1. Provide a totally enclosed design.
   2. Provide a self-locking type to prevent the disc or plug from creeping.
   3. Self-locking worm gears:
      a. One-piece design of AWWA gear bronze material, accurately machine cut.
      b. Provide a hardened alloy steel worm, with thread ground and polished.
   4. Provide proper lubricant for the reduction gearing.
   5. Provide with position indicators to show the position of the valve disc or plug.
   6. Paint the hand wheels the same color as the valve and associated pipeline.
   7. Gear operators shall be provided for all valves in buried or submerged operation.

D. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washers shall be stainless steel.

2.5 VALVE BOXES AND EXTENSION STEMS

A. Provide Minneapolis threaded type, cast iron, with 5-1/4-inch shaft of approximate length for the installation.

B. Cast the word WATER, SEWAGE, GAS, DRAIN into the top of the lid, or label with a stainless steel tag as is appropriate for the service.

C. Provide extension pieces, if required, of the manufacturer's standard type. Units shall be Tyler, Bibby or equal.

D. Provide all units complete with all necessary bases and accessories.

E. Locate the operating nut 6-inches below the top of the valve box where the depth of valve operating nut is more than 3 feet below the top of the valve box.

F. Provide a 2-inch square operating nut.

G. Provide Type 304 stainless steel, galvanized or epoxy coated steel valve extension stems.

2.6 FLOOR BOXES AND EXTENSION STEMS

A. Provide a Clow F-5695, Neenah Foundry R 7506, DeZurik ACC*FB-6, or equal floor box.

B. Provide valve extension stems where required to locate the operating nut in the floor box.

C. Provide a 2-inch square operating nut.

D. Provide all necessary anchor bolts in Type 304 stainless steel.

E. Provide Type 304 stainless steel valve extension stems for submerged extension stem installations.

F. Provide galvanized or epoxy coated steel valve extension stems for all nonsubmerged extension stem installations.

2.7 CHAIN WHEELS AND GUIDES

A. Provide Walworth Company, Figure 804; Clow Valve Company, Figure F-5680; DeZurik Corporation, Series W or LWG; or equal chain wheels and guides.

B. Paint chain wheels and guides.

C. Size chains as recommended by the valve manufacturer and to extend within 4 feet of the operating floor.

D. Provide plated chains of the single loopcoil or babbitt type.

E. Where chains hang in normally traveled areas, provide appropriate "L" type tie back anchors and locate as directed by the Engineer.

2.8 VALVE TAGGING REQUIREMENT

A. Provide a valve tag for each power or air operated valve.

B. See Specification Section 15190 for valve tagging requirements.

2.9 GLOBE VALVES

A. V235: Angle type hose valves 1-1/2 inches and smaller shall have brass or bronze body, with rising stem and composition disc, rated 250-pound WOG minimum. Valves shall have male hose thread on the outlet and female NPT thread on inlet. Valves shall be Crane No. 17TF with Potter-Roemer Fig 2830 male to male adapter and Fig 4605 brass cap; or equal.

2.10 BALL VALVES

A. V300: Ball valves 2 inches and smaller, for general water and air service, shall be bronze, end entry type, two piece with screwed ends, full port, Teflon seats, and hand lever operators, rated 150 SWP, 600 CWP. Valves shall be Apollo 70-100; NIBCO Figure T-585-70; Stockham Figure No. T-285; or equal.

B. V307: Ball valves 2 inches and smaller shall have Type 316 stainless steel bodies with Type 316 stainless steel balls. Valves shall be of the 2 piece type with screwed ends, full bore rated 150 SWP, 600 CWP. Seat, body seal, and stem packing shall be reinforced TFE; valves shall have lever operators. Where required valves shall have an ISO mounting pad for pneumatic or electric actuator. Valves shall be Flow-Tek Series 80; NIBCO T-580-S6-R-66; Stockham Fig. No. S-206-SSMO-R-T; or equal.

2.11 PLUG VALVES

A. V405: Eccentric plug valves 3 inches through 24 inches shall be of the nonlubricated type with wrench lever manual operators for valves 4 inches and smaller and manual gear operators for valves 6 inches and larger. Valves shall be rated 150-pound WOG minimum, rectangular port with minimum 80% port area and shall have a cast iron body ASTM A 126 Class B with flanged ends, balanced ductile iron plug coated with Hycar or Neoprene elastomer, Buna-Vee packing that shall be adjustable and replaceable under pressure in the line, stainless steel bearings, and nickel or stainless steel seats. Minimum seat thickness of 1/8" required; no sprayed or plated seats are acceptable. Valve shall be provided with grit seal for protection of lower body bearing and grease fitting shall be included in upper and lower bearing except for buried and submerged services. Flanges shall be drilled and faced to 125-pound ANSI Standards. DeZurik Water Controls PEC or PEF; Val-Matic 5800F or 5600F/5700F, Victaulic Series 365; or equal.

2.12 CHECK VALVES

A. V845: Ball check valve 4 inches and smaller shall be cast iron body with floating phenolic plastic ball. Valve body shall have an access cover and be coated with epoxy, with nitrile valve seats. Valve shall have threaded ends and have maximum pressure rating of 100 psi. Valves shall be Flowmatic Model 508FB or equal.

B. V850: Duckbill check valves 3 inches and larger shall valve shall be a one-piece, fabric-reinforced elastomer matrix, with slip-on end and 316 stainless steel external clamping bands. The inside diameter of the cuff shall match the outside diameter of the pipe. The valve shall be designed to allow flow in the forward direction, and block flow in the reverse direction. The valve shall have a 100% full round opening on the inlet and shall taper down to a flattened duckbill on the discharge end. Tideflex Model TF-2, Cla-Val Model DBO, or Onyx Model DBS.

C. V870: Ball check valves 6 inches and larger shall be iron body with a sinking type hollow steel ball. Valve body interior surface and ball exterior surface shall be coated with nitrile rubber. Flanges shall be ANSI B16.1, Class 125 flat faced. Valve shall be rated 150-pound WOG, suitable for vertical up or horizontal flow. Valves shall be Flygt HDL; G.A. Industries Figure 240; or equal.

2.13 SPECIAL VALVES

A. V930: Fire hydrant shall be American Flow Control, Waterous Hydrant, Model B-84-B, 7-feet 0-inch bury, 6-inch mechanical joint inlet, and shall be identical to other fire hydrants in the city, no substitutions.

B. V950: Yard hydrant shall be a frost-proof post hydrant for outdoor installation, bronze construction, cast iron casing guard, "T" handle key, with drain hole and valve seat 6 feet below grade. Hydrant shall have NPT inlet and hose connection outlet, and shall be Jay R. Smith Mfg. Co., Figure 5910-5912; Zurn Z1385 – Z1390; or equal.

C. V951: Yard hydrant shall be a frost-proof box hydrant for outdoor installation set flush with ground surface. Bronze construction; cast iron box with hinged, locking cover; "T" handle key; with drain hole and valve seat 6 feet below grade. Hydrant shall have NPT

inlet and hose connection outlet, and shall be Jay R. Smith Mfg. Co., Figure 5810-5814; Zurn; or equal.

D. V971: Natural Gas Pressure Regulating Valves: Provide pressure regulating valves of manufacturers standard materials for natural gas service. Pressure regulators shall be vented, self-operated, spring-loaded type sized equal to the line size upstream of the regulator or sized one pipe size smaller as required based on the required pressure and flow. Valves shall be Fisher Series S202; or equal and shall meet all applicable state and local codes. Provide venting to the building exterior when the regulators are located inside the building.

E. Combination Air Valves:
   1. The combination air valve shall provide for the escape of air to the atmosphere during filling or operation, and allow air to enter during draining or when negative pressure occurs.
   2. Manufacturer: APCO Series 440 SCAV, GA Industries Figure 942, or equal.
   3. Size:
      a. Inlet: 2" NPT
      b. Outlet: 2" NPT
   4. Working pressure: 150 psi.
   5. Valve Construction:
      a. Type: Single body.
      b. Body: Ductile iron, rated to 150 psi.
      c. Float: Stainless steel.
      d. Seat: Buna-N or stainless steel.
      e. Additional internal parts shall be stainless steel or bronze.
   6. Provide flushing attachments for each combination air valve.
   7. Provide V307 isolation ball valves for each combination air valve.

2.14 POWER OPERATED VALVES

A. Flow Valves:
   1. FV-2-1, FV-2-2, FV-2-3
      a. Type: V405 Plug Valves
      b. Size: 12-inch diameter
   2. Electric valve operators:
      a. Manufacturers: AUMA Corporation; EIM; or Rotork.
      b. Actuators -- motor operated, 90 degrees open-close.
      c. The actuators shall be furnished and sized by the valve supplier and shall be factory mounted. The actuators shall be the electric motor gear train type consisting of motor controls, gearbox, geared limit switches and torque switches, and manual override handwheel with declutching lever. The actuators shall be capable of producing not less than 1-1/2 times the required operating torque. The actuators shall be of the self-locking type and shall operate the valve from fully opened to fully closed positions, or the reverse, in approximately 60 seconds. Enclosures shall be NEMA 4X when located in a non-hazardous area, and NEMA 7 explosion proof when in a hazardous area.
      d. Motors shall be 1,800 or 3,600 rpm, 480-volt, three-phase, 60 Hz. high torque, reversible type, totally enclosed, non-ventilated, and shall have

built-in thermal overload protection. Motors shall be pre-lubricated and all bearings shall be of the antifriction type.

e. The gearbox shall be totally enclosed and gasketed with gears and shafts of heat-treated alloy or bronze, supported throughout by antifriction ball or roller bearings and permanently lubricated at the factory. Enclosure shall be ductile iron.

f. Actuator controls:

1) Actuator controls shall consist of reversing contactor motor controller, control power transformer, automatic reset overload relay, local control pushbuttons, indicating lights, OPEN/CLOSE /REMOTE selector switch, terminal strip, and space heater.

2) When the OPEN/CLOSE/REMOTE selector is in the REMOTE position, the actuator shall be controlled by external maintained OPEN and CLOSED contact inputs and shall provide contact closures for REMOTE indication of position. Provide one contact closure each for full open and full closed position. When the OPEN/CLOSE /REMOTE selector is in the OPEN or CLOSE position the actuator shall be controlled by integral push buttons. The actuator controls shall accept both momentary or maintained OPEN and CLOSE contact inputs.

g. The actuators shall be equipped with automatic double-acting geared limit switches and double-acting torque switches. Limit switches shall be geared directly to the operating gear train and shall be of the adjustable type capable of being adjusted to trip at any point between fully opened and fully closed valve positions. Torque switches shall operate during the complete valve cycle to protect the valve from excessive loads met by obstructions in either direction of travel. The actuators shall provide one set of OPEN and CLOSED dry contact outputs for external use.

h. The actuators shall be equipped with handwheels for manual operation, which shall include an automatic clutch to positively disengage the handwheel at any time the drive motor control is energized. Handwheel operator shall be designed in such a way that failure of the motorized gearing shall not prevent hand operation of the valves.

PART 3 EXECUTION

3.1 GENERAL

A. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Before installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance.

B. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods. Apply approved joint compound to threads before making joints. Joints shall be watertight at test pressures before acceptance.

3.2 PLACING

A. Where centerline of manually operated valves are over 6 feet 9 inches above the floor line, chain wheel and guide assemblies or chain lever assemblies shall be furnished and installed for operation of the valves, unless otherwise directed by the Engineer.

B. Generally, unless otherwise indicated on the Drawings, all valves installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the finish floor shall be installed with their operating stems vertical. Valves installed in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the finish floor shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems and operating handwheel shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems orientated to facilitate the most practicable operation.

3.3 TESTING

A. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage under test. Repair joints that show signs of leakage before final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. Correct any damage caused by the testing.

B. If requested by the Engineer, the valve manufacturer shall furnish an affidavit stating the materials options furnished and/or that he has complied with these and other referenced specifications.

3.4 MANUFACTURER'S SERVICES FOR POWER OPERATED VALVES

A. Provide manufacturer's services under the provisions of Division 1.

B. Minimum Service Requirements:
   1. Installation: As required for proper installation.
   2. Operator training: One half day on site.
   3. Service to Repair Defective Work: Provide during one-year warranty period under the provisions of General Conditions.

END OF SECTION

SECTION 15121

ALUMINUM STOP LOGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stop logs and appurtenances.

B. Stop gates are shown on the Drawings and described in the Hydraulic Gate Schedule, Drawing 20-C-2.

1.2 DESIGN REQUIREMENTS

A. Stop log hydraulic requirements and dimensions are described in the Hydraulic Gate Schedule.

B. Maximum leakage under seating head conditions: 0.05 gpm per wetted foot of seating perimeter.

1.3 SUBMITTALS

A. Shop Drawings: Submit under the provisions of Division 1, including the following:
   1. Identify all submittal data with the gate numbers shown on the Drawings.
   2. Include all stop logs in a single submittal package. Partial or incomplete submittals will not be reviewed.
   3. Complete description of gates, including components, materials and weights.
   4. Drawings of each size and type of gate.
   5. Calculations showing required force to remove each stop log.

B. Furnish operation and maintenance manuals under the provisions of Division 1.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle the equipment under the provisions of Division 1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. RW Gate, Troy, NY.

B. Whipps, Inc., Athol, MA.

2.2 GENERAL

A. All equipment shall be the end product of one manufacturer. The manufacturer shall be responsible for all gates and all items covered herein.

2.3 METAL FABRICATION

A. Anchor bolts, fasteners, nuts, and washers: 316 stainless steel.

2.4 COMPONENTS

A. Logs:
   1. Construction: Minimum 1/4-inch thick aluminum plate, alloy 6061-T6.
   2. Maximum design deflection at full head: 1/360 of span.
   3. Stop logs shall be designed to lower into place through gravity with no external downward force necessary.
   4. Lifting pins or slots shall be provided for each log.
   5. Provide continuous EPDM or neoprene seals mounted on the bottom and sides of all stop logs. Seals shall be field removable and replaceable.
   6. Stop logs shall be identical and designed to stack in any sequence.

B. Gate Frame:
   1. Construction: Fabricated 6061-T6 aluminum frame.
   2. Provide holes for mounting as required.

C. Lifting Device:
   1. Provide one aluminum lifting device capable of installing and removing all stop logs of the same width from the operating level.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install gates in accordance with Drawings, shop drawings and manufacturer's instructions. Grout in place using a non-shrink grout.

3.2 MANUFACTURER'S SERVICES

A. Provide manufacturer's services under the provisions of Division 1.

B. Minimum service requirements:
   1. Installation: As required for proper installation.
   2. Start-up and field testing: 2 hours on site.

C. Service to Repair Defective Work: Provide during one year warranty period under provisions of General Conditions.

END OF SECTION

SECTION 15135

METERS AND GAUGES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure Gauges and Fittings:
   1. Pressure gauges and seals for process systems.
   2. Gauges furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 15 sections.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI B16.1-89 - Cast-Iron Pipe Flanges and Flanged Fittings.
   2. ANSI B26.24-79 - Bronze Pipe Flanges and Flanged Fittings Class 150 and 300.
   3. ANSI B31.1-89 - Power Piping.
   4. ANSI B40.1-85 - Gauges-Pressure Indicating Dial Type - Elastic Element.

B. Instrument Society of America (ISA).

1.3 SUBMITTALS

A. Shop Drawings: Submit under the provisions of Division 1, including the following:
   1. Manufacturer's technical product data, including installation instructions, for each type meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated.
   2. Meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
   2. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

B. Certification: Provide manufacturer certified meters and gauges meeting accuracies of specified operating conditions.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES, PRESSURE SWITCHES AND SEALS FOR PROCESS SYSTEMS

A. General:
1. Provide gauges for the suction and discharge of pumps as shown on the Drawings.
2. Provide diaphragm seals for all sludge piping system gauges and as shown on the Drawings.

B. Pressure Gauges:
1. Manufacturer:
a. Ashcroft Model 1279 greater than 10 psig.
b. Ashcroft Model 1188 less than 10 psig.
c. Or equal.
2. Dial Size: 4 ½-inch unless otherwise noted.
3. Gauge Case Material: Phenolic plastic with stainless steel snap ring.
4. Sensing Element Material:
a. Bourdon tube: Phosphor-bronze.
b. Bellows: Brass.
5. Provide a liquid filled gauge.

C. Diaphragm Seals:
1. Manufacturer:
a. Ashcroft Series 100.
b. Or equal.
2. Pressure Rating: 1500 psig.
3. Bottom and Top Housing Material: AISI 316 stainless steel.
4. Diaphragm Materials: AISI 316L stainless steel.
5. Filling Fluid: Glycerin or manufacturers recommended fluid for material compatibility.
6. Manufacturer to assemble, fill, and calibrate associated pressure gauge and switch.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION OF PRESSURE GAUGES AND SWITCHES

A. Install gauges in vertical upright position in the position most easily read by observer standing on floor.

B. Do not turn or loosen gauges or switches on sealed systems.

3.3 CLEANING

A. Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

3.4 SCHEDULE OF PRESSURE GAUGES, PRESSURE SWITCHES AND SEALS FOR PROCESS SYSTEMS

A. Pressure Gauges and Diaphragm Seals:

Tag	Range
PI/PE-2-1	0 - 60 PSI
PI/PE-2-2	0 - 60 PSI

END OF SECTION

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SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.2 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Submit list of wording, symbols, letter size, and color-coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit two nameplates, tags, labels (1¼-inch letters) and directional arrows.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Record actual locations of tagged valves.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle the equipment under the provisions of Division 1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Brady (WH) Co., Signmark Div.

B. Allen Systems, Inc.

C. Industrial Safety Supply Co.

D. Seton Name Plate Corporation.

E. Or equal.

2.2 NAMEPLATES

A. Laminated three-layer plastic with engraved black letters on light contrasting background color.

B. Provide identification nameplates bearing the full equipment name and tag number as shown on the Drawings.

2.3 TAGS

A. Laminated three-layer plastic with engraved black letters on light contrasting background color.

B. Tag size minimum 1½-inch diameter.

C. Provide identification tags bearing the control valve or instrument tag number as shown on the Drawings. The equipment tag number is shown on the Process & Instrumentation Drawings.

2.4 PIPE MARKERS

A. Self-Sticking Pipe Markers and Arrow Tape:
   1. High-gloss, dimensionally stable vinyl film with an acrylic pressure-sensitive adhesive resistant to moisture, oils, solvents, and weathering.
   2. Provide labels and arrows as manufactured by W.H. Brady Company, Milwaukee, WI., Style B-946; Seton Nameplate Corporation, New Haven, CT.; or equal.

B. Mechanically Affixed Pipe Markers:
   1. Surface protected, pre-printed, pre-coiled, plastic tubes that are either pre-printed or can except the self-sticking pipe markers and arrows applied.
   2. Provide mechanically affixed pipe markers as manufactured by W.H. Brady Company, Milwaukee, WI., Style B-915; Seton Nameplate Corporation, New Haven, CT., Snap-On Markers; or equal.

C. Pipe Markers and Arrow Coloring:
   1. All pipe marking will comply with ANSI 13.1 Scheme for the Identification of Piping Systems.
   2. Standard coloring: Provide labels and arrows with black lettering and on a yellow background, unless noted otherwise on the Drawings Piping Schedule.
   3. Provide arrow tape with the same background color as the labels background color, and the same arrow color as the labels lettering color.

D. Label Lettering:

1. All pipe marking will comply with ANSI 13.1 Scheme for the Identification of Piping Systems.
2. All markers must be in compliance with respect to proper letter color, proper letter size, correct background color and proper marker size (length).
3. Provide identification labels bearing the full piping system name as shown on the Drawings. The label name is shown under the "Service" column on the Piping Schedule, Drawing 95-M-1.
4. Provide labels with lettering sized per the requirements of the following lettering height schedule:

LETTERING HEIGHT SCHEDULE

Outside Pipe Diameter (Inch)	Minimum Letter Height (Inch)
¾ - 1¼	½
1½ - 2	¾
2½ - 6	1¼
8 and over	2½

E. Directional Flow Arrows:

1. Provide roll mounted directional flow arrows with the directional arrows printed directly on color- coded banding tape.
2. Supply the directional flow arrows from the same manufacturer that supplies the labels.

2.5 PIPE BANDING

A. Self-Sticking Pipe Banding:

1. High-gloss, dimensionally stable vinyl film with an acrylic pressure-sensitive adhesive resistant to moisture, oils, solvents, and weathering.
2. Provide banding as manufactured by W.H. Brady Company, Milwaukee, WI., Style B-946; Seton Nameplate Corporation, New Haven, CT.; or equal.

B. Mechanically Affixed Pipe Bands:

1. Surface protected, pre-printed, pre-coiled, color-coded plastic tubes.
2. Provide mechanically affixed pipe markers as manufactured by W.H. Brady Company, Milwaukee, WI., Style B-915; Seton Nameplate Corporation, New Haven, CT., Snap-On Markers; or equal.

C. Provide 6-inch wide color bands, color and number as specified hereinafter.

D. Space multiple bands 3/4-inch apart.

E. Band Coloring:
1. All pipe marking will comply with ANSI 13.1 Scheme for the Identification of Piping Systems.
2. Provide pipe band per the requirements of the Drawings. The pipe banding requirements and color is shown under the "Remarks" column on the Piping Schedule, Drawing 95-M-1.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Pipe Labeling:
1. Banding: Apply banding at all connections to equipment, valves, or branch fittings, at wall boundaries and at intervals along the piping not greater than 30 inches on center, with at least one band applied to each exposed run of pipe.
2. Pipe Markers and Directional Arrows:
   a. Locate labels at all connections to equipment, valves, or branching fittings, at wall boundaries, and at intervals along the piping not greater than 18 feet on center.
   b. Each pipe shall be adequately labeled with a minimum of 2 labels in each room, crawl space or compartment.
   c. Locate separate flow directional arrows on each side of pipe marker indicating direction of flow.
   d. If flow is bi-directional, use double headed arrows.

B. Equipment Labeling:
1. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
2. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
3. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

C. Equipment Tags:
1. Install tags with corrosion resistant chain.
2. Tag all control valves and instruments.

END OF SECTION

SECTION 15400

BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

D. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

E. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.3 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.5 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces

D. Coordination Meetings: Attend coordination meetings with the construction manager and all other trades for the purpose of coordinating the locations of all fire protection, plumbing, HVAC and electrical work for the entire project. The goal of these meetings is to avoid conflicts between trades in the field.

E. Conflicts between Trades: Resolve all conflicts with other trades at no additional cost to the Owner or Architect.

F. Water Utility Service Coordination: Coordinate with the local water utility the installation of the new water service. Coordinate the installation of the water service utility meter with the local water utility and the requirements of the water meter manufacturer.

1.6 INTENT OF DRAWINGS AND SPECIFICATIONS

A. These specifications and attendant drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material necessary for the proper execution of the work in accordance with present practices of the trade shall not relieve the Contractor from providing such additional labor and materials.

B. The drawings depicting plumbing work are diagrammatic and show, in their approximate location, symbols representing plumbing equipment and devices. The exact location of such equipment and devices shall be established in the field in accordance with instructions from the Architect and/or established by manufacturer's installation drawings and details.

1. The Contractor shall refer to shop drawings and submittal drawings for all equipment requiring plumbing connections to verify rough-in and connection locations.

2. Unless specifically stated to the contrary, no measurement of an plumbing drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the plumbing drawings are subject to measurements of adjacent and previously completed work. All measurements shall be performed prior to the actual installation of equipment.

1.7 DRAWINGS

A. The plumbing drawings do not attempt to show the complete details of building construction, which affect the plumbing installation. The Contractor shall refer to the architectural, civil, structural and mechanical, and electrical drawings for additional details, which affect the proper installation of this work. Bring any discrepancies to the attention of the Engineer for resolution. The Contractor is cautioned that diagrams showing plumbing connections and/or piping are diagrammatic only and must not be used for obtaining lineal runs of piping. Piping diagrams do not necessarily show the exact physical arrangement of the equipment.

B. The Contractor shall be responsible for all existing field conditions; review existing field conditions prior to bid and shall take into account in bid proposal. No additional compensation will be allowed due to Contractor's failure to include all necessary work in the bid proposal.

1.8 MATERIAL AND EQUIPMENT

A. All material and equipment shall be new and of the quality used for the purpose in good commercial practice, and shall be standard product of reputable manufacturers. Each major component of equipment shall have the manufacturer's name, catalog number, and capacity or rating on a nameplate, securely affixed on the equipment in a conspicuous place.

1.9 COOPERATION WITH OTHER TRADES

A. This Contractor shall completely cooperate with all other trades in the matter of planning and executing of the work. Every reasonable effort shall be made to prevent conflict and interferences as to space requirements, dimensions, locations, openings, sleeving or other matters, which tend to delay or obstruct the work of any trade.

1.10 CUTTING AND PATCHING

A. As necessary and with approval to permit the installation of piping or any part of the work under this branch. Any cost caused by defective or ill-timed work shall be by the party responsible there for. Patching of holes, openings, etc. resulting from the work of this branch shall be furnished by this Contractor.

1.11 STANDARDS, CODES AND PERMITS

A. All work shall be installed in accordance with National, State and Local plumbing codes, laws, ordinances and regulations. Comply with all applicable OSHA regulations.

B. All materials shall have a U.L. label where a U.L. standard and/or test exists.

C. Prepare and submit to all authorities having jurisdiction, for their approval, all applications and working drawings required by them. Secure and pay for all permits and licenses required.

1.12 SHOP DRAWINGS

A. Submit per Division 1 Requirements. Only submit shop drawings/product information requested within each section. Unsolicited submittals will be returned un-reviewed.

1.13 WORKMANSHIP

A. The installation of all work shall be made so that its several component parts will function as a workable system complete with all accessories necessary for its operation, and shall be left with all equipment properly adjusted and in working order. The work shall be executed in conformity with the best-accepted standard practice of the trade so as to contribute to efficiency and appearance. It shall also be executed so that the installation will conform and adjust itself to the building structure, its equipment and its usage.

1.14 DRAWINGS OF OTHER TRADES

A. The Contractor shall consult the drawings of the work for the various other trades; field layouts of the parties performing the work of the other trades; their shop drawings, and he shall be governed accordingly in laying out his work.

1.15 FIELD MEASUREMENTS

A. The Contractor shall take all field measurements necessary for his work and shall assume the full responsibility for their accuracy.

1.16 STRUCTURAL INTERFERENCES

A. Should any structural interference prevent the installation of the fixtures, running of piping, etc., at points shown on drawings, the necessary minor deviation there from, as determined by the Architect, may be permitted. Minor changes in the position of the fixtures, equipment or piping if decided upon before any work has been done by the Contractor shall be made without additional charge.

1.17 EXAMINATION OF PLANS, SPECIFICATIONS AND SITE

A. Before submitting a bid, the Contractor shall visit the site and familiarize himself with all features of the building and site, which may affect the execution of his work. No extra payment will be allowed for the failure to obtain this information. If in the opinion of the Contractor there are omissions or errors in the plans or specifications, the Contractor shall clarify these points with the Engineer before submitting his bid. In lieu of written clarification by addendum, the contractor shall resolve all conflicts in favor of the greater quantity or better quality.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:
   a. Cascade Waterworks Mfg. Co.
   b. Dresser Industries, Inc.; DMD Div.
   c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
   d. Viking Johnson.

2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.

3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.

4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:
    a. Eslon Thermoplastics.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:
    a. NIBCO INC.

D. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:
    a. Cascade Waterworks Mfg. Co.
    b. Fernco, Inc.
    c. Mission Rubber Company.
    d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

1. Manufacturers:
    a. Eclipse, Inc.
    b. Epco Sales, Inc.
    c. Hart Industries, International, Inc.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:
    a. Calpico, Inc.
    b. Lochinvar Corp.

E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:
    a. Precision Plumbing Products, Inc.

b. Sioux Chief Manufacturing Co., Inc.
c. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

E. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw, polished chrome-plated or rough brass finish.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw, polished chrome-plated or rough brass finish.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping connected to devices, equipment, solenoid valves, backflow preventers, etc. with a union or flange connection at device to permit device removal and servicing.

H. Install piping at indicated slopes.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install piping to allow application of insulation.

L. Select system components with pressure rating equal to or greater than system operating pressure.

M. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type with spring clips.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
   f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
   g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
   h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:
   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
   f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

N. Sleeves are not required for core-drilled holes.

O. Permanent sleeves are not required for holes formed by removable PE sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

Q. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
        1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

R. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

T. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

U. Verify final equipment locations for roughing-in.

V. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

3. PVC Non-pressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION

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SECTION 15405

PLUMBING HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes hangers and supports for plumbing system piping and equipment.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.4 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-Line Systems, Inc.

2. Globe Pipe Hanger Products, Inc.

3. Grinnell Corp.

4. GS Metals Corp.

5. National Pipe Hanger Corp.

2.2 MANUFACTURED UNITS

A. General: All Supports and Hangers used in General locations shall be Galvanized.

B. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

1. Galvanized, Metallic Coatings: For all general locations.

2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

3. Stainless Steel: For piping and equipment that is located in corrosive areas.

C. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Coatings: Galvanized.

2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

3. Stainless Steel: For piping and equipment that is located in corrosive areas.

D. Thermal-Hanger Shield Inserts: 100-psi (690-kPa) minimum compressive-strength insulation, encased in sheet metal shield.

1. Material: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.

2. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.

3. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.

4. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of uninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).

2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN20 to DN600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.

3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN15 to DN600), if little or no insulation is required.

4. Adjustable Steel Band Hangers (MSS Type 7): For suspension of uninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).

5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of uninsulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).

6. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of uninsulated stationary pipes, NPS 3/8 to NPS 8 (DN10 to DN200).

7. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30 (DN15 to DN750).

8. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).

E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.

2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

4. C-Clamps (MSS Type 23): For structural shapes.

5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

7. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

a. Light (MSS Type 31): 750 lb (340 kg).
b. Medium (MSS Type 32): 1500 lb (675 kg).
c. Heavy (MSS Type 33): 3000 lb (1350 kg).

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

2. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi (690-kPa) minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Field assemble and install according to manufacturer's written instructions.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

J. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.9.

2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2 (DN8 to DN90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.

5. Insert Material: Length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 15407

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following plumbing identification materials and their installation:

1. Pipe markers.

2. Stencils.

3. Valve tags.

4. Warning tags.

1.2 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.

2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.

4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.

5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

C. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.

2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.2 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme approved by Architect. Provide 5/32-inch (4-mm) hole for fastener.

1. Material: 0.032-inch- (0.8-mm-) thick brass or aluminum.

2. Valve-Tag Fasteners: Brass wire-link or beaded chain.

2.3 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.

2. Fasteners: Reinforced grommet and wire or string.

3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch (19 mm) wide, lapped at least 1-1/2 inches (38 mm) at both ends of pipe marker, and covering full circumference of pipe.

2. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches (38 mm) wide, lapped at least 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. Near each valve.

2. Near each branch connection, excluding short branches for fixtures. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.5 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.6 CLEANING

A. Clean faces of mechanical identification devices.

END OF SECTION

SECTION 15408

PLUMBING PIPE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.4 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Plumbing Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for insulation application.

1.5 SCHEDULING

A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mineral-Fiber Insulation:

a. CertainTeed Manson.
b. Knauf FiberGlass GmbH.
c. Owens-Corning Fiberglas Corp.
d. Schuller International, Inc.

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.

2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.

4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.

5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.

6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.

2. PVC Jacket Color: White.

D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- (0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.

2. Adhesive: As recommended by insulation material manufacturer.

2.4 ACCESSORIES AND ATTACHMENTS

A. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.

2. Aluminum: 0.007 inch (0.18 mm) thick.

3. Nickel-Copper Alloy: 0.005 inch (0.13 mm) thick.

B. Wire: 0.080-inch (2.0-mm), nickel-copper alloy; 0.062-inch (1.6-mm), soft-annealed, stainless steel; or 0.062-inch (1.6-mm), soft-annealed, galvanized steel.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.

3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.

2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.

3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.

3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.

3. Apply insulation to flanges as specified for flange insulation application.

4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FIELD-APPLIED JACKET APPLICATION

A. Foil and Paper Jackets: Apply foil and paper jackets where piping is concealed.

1. Draw jacket material smooth and tight.

2. Apply lap or joint strips with the same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch-(75-mm-) wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

B. Apply PVC jacket on all exposed piping. Wrap Jacket with minimum 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

3.6 FINISHES

A. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.7 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.

2. Vibration-control devices.

3. Drainage piping located in crawl spaces, unless otherwise indicated.

4. Below-grade piping, unless otherwise indicated.

5. Chrome-plated pipes and fittings, unless potential for personnel injury.

6. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.8 FIELD QUALITY CONTROL

A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect fittings and valves randomly selected by Engineer.

B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.9 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.10 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic (W1) hot, & cold which are piped utilizing copper or steel or stainless steel piping. (For W1 water piped utilizing Schedule 80 CPVC – no insulation required.)

1. Operating Temperature: 50 to 140 deg F (15 to 60 deg C).

2. Insulation Material: Mineral fiber.

3. Insulation Thickness: 1 (one) inch.

4. Vapor Retarder Required: No.

5. Jacket:
   a. FSK where piping is concealed;
   b. PVC where piping is exposed (protects insulation from washdown activities).

END OF SECTION

SECTION 15410

PLUMBING VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following general-duty valves:

1. Copper-alloy ball valves.

2. CPVC ball valves.

1.2 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.

2. EPDM: Ethylene-propylene-diene terpolymer rubber.

3. NBR: Acrylonitrile-butadiene rubber.

4. PTFE: Polytetrafluoroethylene plastic.

5. TFE: Tetrafluoroethylene plastic.

1.3 QUALITY ASSURANCE

A. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping and storage as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.

3. Set angle, gate, and globe valves closed to prevent rattling.

4. Set ball valves open to minimize exposure of functional surfaces.

5. Block check valves in either closed or open position.

B. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.

C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

E. Valve Actuators:

1. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller.

F. Extended Valve Stems: On insulated valves.

2.3 COPPER-ALLOY BALL VALVES

A. Manufacturers:

1. Copper-Alloy Ball Valves:
   a. Grinnell Corporation.
   b. Milwaukee Valve Company
   c. NIBCO INC.
   d. Watts Industries, Inc.; Water Products Div.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Two--Piece, Copper-Alloy Ball Valves: Bronze body with full -port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4137-kPa) minimum CWP rating and blowout-proof stem.

2.4 CPVC BALL VALVES

A. CPVC Union Ball Valves: MSS SP-122, with full-port ball, socket detachable end connectors, PTFE seat, EPDM or Viton O-rings, and pressure rating not less than 150 psig (1035 kPa) at 73 deg F, NSF listed for potable water use.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, gate or butterfly valves.

2. Throttling Service: Ball or butterfly valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig (4137-kPa) CWP rating, copper alloy.
   a. For CPVC piping, utilize CPVC ball valves.

D. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION

SECTION 15420

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.

1. This applies to the following piping systems which are 4” diameter and less shown on the plumbing drawings.
   a. W1 – Potable Water

B. Related Sections include the following:

1. Division 15 Section "Plumbing Specialties" for water distribution piping specialties.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Service Piping: 160 psig (1100 kPa).

2. Domestic Water Distribution Piping: 125 psig (860 kPa).

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61

C. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

D. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 COPPER TUBING

A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A), water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2.3 CPVC PIPING

A. CPVC Schedule 80 Pipe: ASTM F 441/F 441M, NSF listed for potable water use.

1. CPVC Schedule 80 Fittings: ASTM F 439, socket type, NSF listed for potable water use.

a. Metal-to-Plastic Transitions: Schedule 80 CPVC with molded-in-place ANSI B1.20.1 threaded metal insert and internal O-ring seal, NSF listed for potable water use.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, non-metallic and asbestos free unless otherwise indicated.

2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 PE ENCASEMENT

A. PE Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105 PE film, 0.008-inch (0.20-mm) minimum thickness, tube or sheet.

2.6 VALVES

A. Refer to Division 15 Section "Valves" for bronze, and CPVC, general-duty valves.

B. Refer to Division 15 Section "Plumbing Specialties" for balancing and drain valves.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install domestic water piping level without pitch and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors

R. Install sleeve seals for piping penetrations of concrete walls and slabs

S. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

I. Install transition couplings at joints of dissimilar piping.

J. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.

2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.

3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

4. NPS 2-1/2: 108 inches with 1/2-inch rod.

5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

6. NPS 6: 10 feet with 5/8-inch rod.

7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

2. NPS 6: 12 feet with 3/4-inch rod.

3. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

G. Install supports for vertical stainless-steel piping every 15 feet.

H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 15 plumbing fixture Sections.

3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.6 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 15 Section "Plumbing Identification."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
   f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.9 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Repeat procedures if biological examination shows contamination.

e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-Building-Slab:

1. Domestic water, building-service piping:
   a. NPS 3 and smaller: Soft copper tube, ASTM B 88, Type K wrought-copper, solder-joint fittings; and brazed joints.
   b. NPS 4 and larger, shall be one of the following:
      1) Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
      2) Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
      3) Push-on-joint, ductile-iron pipe; standard-pattern, push-on-joint fittings; and gasketed joints.

2. Domestic water piping, NPS 2 and smaller, shall be one of the following:
   a. Soft copper tube, ASTM B 88, Type K); wrought-copper, solder-joint fittings; and brazed joints.

E. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:

1. NPS 3 and smaller: Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

2. NPS 4 to NPS 8, shall be one of the following:
   a. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
   b. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3. For areas which required corrosive resistant construction and/or tempered water, utilize Schedule 80 CPVC pipe. Make transition from Copper to CPVC before pipe route enters area.

3.11 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.

2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.

3. Drain Duty: Hose-end drain valves.

END OF SECTION

SECTION 15430

PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following plumbing specialties:

1. Backflow preventers.

2. Strainers.

3. Hose Bibs.

4. Miscellaneous piping specialties.

5. Sleeve penetration systems.

6. Flashing materials.

1.2 DEFINITIONS

A. The following are industry abbreviations for plastic piping materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.

2. PE: Polyethylene plastic.

3. PUR: Polyurethane plastic.

4. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 125 psig (860 kPa) .

2. Sanitary Waste and Vent Piping: 10-foot head of water (30 kPa).

1.4 SUBMITTALS

A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:

1. Backflow preventers.

B. Field test reports.

C. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:

1. Backflow preventers.

2. Hose stations and hydrants.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

D. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.

2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.6 MAINTENANCE AGREEMENT

A. Reduced pressure backflow preventer:

1. Provide a 2-year service contract from date of acceptance. Include field check by manufacturer’s representative after the first and second year of acceptance date.

2. Submit required forms to regulatory authority and pay any required fees; copy Owner and Engineer.

3. Instruct Owner as to frequency and manner in which service check is to be performed.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Manufacturers:

1. Watts Industries, Inc.

2. Or equal.

B. General: ASSE standard, backflow preventers.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.

2. Interior Components: Corrosion-resistant materials.

3. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.

4. Strainer: On inlet, if indicated.

C. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.

D. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.

1. Pressure Loss: 12-psig (83 kPa) maximum, through middle 1/3 of flow range.

E. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm (0.19-L/s) flow and applications with up to 10-foot head of water (30-kPa) back pressure. Include two check valves; intermediate atmospheric vent; and non-removable, ASME B1.20.7, garden-hose threads on outlet.

2.2 STRAINERS

A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.

1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.

2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.

3. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.

a. Drain: Pipe plug.

2.3 DRAIN VALVES

A. Hose-End Drain Valve: MSS SP-80, gate valve, Class 125, ASTM B 62 bronze body, with NPS 3/4 (DN 20) threaded or solder-joint inlet and ASME B1.20.7, garden-hose threads on outlet and cap. Hose bibbs are prohibited for this application.

2.4 MISCELLANEOUS PIPING SPECIALTIES

A. Hose Bibbs: As noted on Plan.

2.5 SLEEVE PENETRATION SYSTEMS

A. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.

1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.

2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.

3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3. Install union in piping directly downstream of backflow preventer to allow servicing and removal of unit without major piping disruptions.

4. Do not install bypass piping around backflow preventers.

C. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

D. Fasten recessed-type plumbing specialties to reinforcement built into walls.

E. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

F. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.

G. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect plumbing specialties to piping specified in other Division 15 Sections.

D. Ground equipment.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Connect plumbing specialties and devices that require power according to Division 16 Sections.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each backflow preventer, thermostatic water mixing valve, water tempering valve.

1. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 15500

BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. This section includes general administrative and procedural requirements for HVAC installations.

1.2 REGULATORY REQUIREMENTS

A. Conform to all state and local code requirements.

B. Obtain permits and request inspections from authority having jurisdiction and pay for all fees incidental thereto.

1.3 PROJECT/SITE CONDITIONS

A. Install work in locations shown on drawings, unless prevented by project conditions.

B. Before submitting a bid, the Contractor shall visit the site and familiarize himself with all features of the building and site, which may affect the execution of his work. No extra payment will be allowed for the failure to obtain this information. If in the opinion of the Contractor there are omissions or errors in the plans or specifications, the Contractor shall clarify these points with the Engineer before submitting his bid. In lieu of written clarification by addendum, the contractor shall resolve all conflicts in favor of the greater quantity or better quality.

C. Project design is based around the first listed manufacturer in relative specification sections. Subsequent manufacturers listed are also acceptable. However, the use of these manufacturers may result in minor design changes involving equipment layout, supports, etc. Substituted manufacturers other than those listed will not be allowed. The Contractor shall be responsible for such and include any modifications required as part of his bid.

D. It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site with the Owner's representative and be responsible for their accuracy. Where appropriate the location shall be established in accordance with the manufacturer's installation drawings and details subject to the Engineer's review.

E. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of Engineer before proceeding.

1.4 QUALITY ASSURANCE

A. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

1.7 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.8 HVAC INSTALLATIONS

A. Coordinate HVAC equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.

F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

G. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

H. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

I. Coordinate the installation of mechanical materials and equipment above ceilings with suspension system, light fixtures, and other installations.

1.9 CUTTING AND PATCHING

A. This article specifies the cutting and patching of mechanical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment.

B. Cutting and patching shall be performed per Division 1 section entitled Cutting and Patching. Where referenced section is not included as part of this specification and as a minimum, the Contractor shall perform cutting and patching as outlined in this article.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.

E. Where changes or removal of existing equipment, devices, etc. takes place. Contractor shall be responsible for restoring surfaces where original equipment devices, etc. were originally located to match existing surrounding surfaces.

F. No additional compensation will be authorized for cutting and patching work that is necessitated by ill timed, defective, or non-conforming installations.

G. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
   1. Uncover work to provide for installation of ill timed work;
   2. Remove and replace defective work;
   3. Remove and replace work not conforming to requirements of the Contract Documents.
   4. Install equipment and materials in existing structures.

H. Cut, remove, and legally dispose of selected mechanical equipment, components, and materials as indicated including, but not limited to, removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new work.

I. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

J. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

K. Locate, identify, and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.

1.10 ELECTRICAL CONNECTIONS

A. Line voltage wiring (115 volts and over) required for the connection of the heating and ventilating equipment to be done under Division 16; line voltage temperature control wiring required for the operation of the HVAC system shall be under Division 15, unless shown on the electrical drawings (Division 16). Low voltage wiring (below 115 volts) to be done by the HVAC Contractor but shall conform to Division 16 requirements.

B. The HVAC Contractor to furnish necessary controls, wiring diagrams, and instruction sheets, and coordinate his work with that of the Electrical Contractor to assure proper connection and operation of controls and equipment.

C. The HVAC Contractor to be responsible for the operation of the system, temperature, safety, and other controls on the work during installation and guarantee period including equipment furnished by Owner.

D. Magnetic starters, pushbutton stations, pilot lights, etc. not an integral part of packaged mechanical equipment, to be furnished under Division 16, unless otherwise noted in the equipment specification section or equipment schedule.

E. Magnetic starters, pushbutton stations, pilot lights, etc, shall conform to Division 16 requirements. Manufacturers of starters shall be of same manufacturer as starter gear furnished as part of Division 16.

F. Disconnect switches, fused disconnects, capped safety switches, etc. shall be furnished by the HVAC contractor whether specifically noted or not. Devices shall conform to Division 16 requirements.

G. Electrical work and connections to be per Division 16 requirements.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Conform to the General Conditions and Division 1.

1.12 PROJECT RECORD DOCUMENTS

A. Conform to the General Conditions and Division 1.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 15515

BASIC HVAC SYSTEM MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Sleeves.
   3. Escutcheons.
   4. Pipe Penetrations
   5. Duct Penetrations
   6. Mechanical demolition.
   7. Equipment installation requirements common to equipment sections.
   8. Painting and finishing.
   9. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.3 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.5 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS – GENERAL

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS – GENERAL

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 PIPE PENETRATIONS – GENERAL

A. Provide steel pipe sleeves with minimum wall thickness of 1/4 inch for pipes passing through beams and walls of concrete, brick, tile, or masonry, and 22 gage galvanized iron sleeves for pipes passing through other parts of construction. Provide steel pipe for all sleeves penetrating floors. Furnish each sleeve having inside diameter 1 inch larger than outside diameter of un-insulated and insulated pipe, unless wall or floor is a firewall, in which case, only the pipe shall penetrate.

B. For pipes passing through floors, walls, and ceilings provide chrome-plated brass escutcheons having outside diameter to cover sleeved openings and inside diameter to fit pipe.

C. Fire and smoke-rated surfaces.

1. 3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, 3M CS 195 composite sheet, Pipe Shields Inc. Series F fire barrier kits, Proset Systems fire rated floor and wall penetrations, Insta Foam Products Insta Fire Seal Firestop Foam, Dow Corning Fire Stop System.
2. UL-listed or tested by an independent testing laboratory, approved by the State or Local Code jurisdictions. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Sleeves in concrete to be schedule 40 steel pipe with integral water stop unless the fire stop material used includes a sleeve that is an integral part of the rated assembly.

D. Non-rated surfaces

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor-ceiling plates for covering openings in occupied spaces.
2. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water stop type wall sleeve.
3. At interior partitions where pipe penetrations are sealed, use Tremco Dymonic, Sika Corp. Sikaflex 1a, Sonneborn Sonolastic NPI, or Mameco Vulken 116 urethane caulk to affect the seal. Use galvanized sheet metal sleeves in hollow wall penetrations.

2.5 DUCT PENETRATIONS – GENERAL

A. Fire and smoke-rated surfaces:

1. 3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, Insta Foam Products Insta Fire Seal Firestop Foam, Dow Corning Fire Stop System.

2. UL listed or tested by an independent testing laboratory, approved by the State and Local Code jurisdictions. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Sleeves in concrete to be minimum 16-gauge galvanized steel sleeves.

B. Non-rated surfaces. Fiberglass insulation fill at voids with galvanized steel sheet metal bank-off on both side of duct penetration through walls. Use fire resistant sealant for sealing and soundproofing.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Sleeves are required for core-drilled holes; see detail at end of this section.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
    a) Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a) Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b) Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials.

O. Verify final equipment locations for roughing-in.

P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS – GENERAL

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION

SECTION 15525

SUPPORTS, ANCHORS, SLEEVES, AND SEALING FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes specifications for supports of all HVAC equipment and materials as well as piping system anchors, sleeves, and sealing.

1.2 REFERENCES

A. MSS SP-58 Pipe Hangers and Supports - Materials, Design, and Manufacture

B. MSS SP-59 Pipe Hangers and Supports - Selection and Application

PART 2 - PRODUCTS

2.1 STRUCTURAL SUPPORT

A. Provide all supporting steel required for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support mechanical equipment.

B. Provide support, anchors, and sleeves compatible with atmosphere where located. For applications located in corrosive atmospheres such as chemical rooms or rooms with high moisture, use Stainless Steel version of hanger model and type listed in this Section. All other areas shall use Galvanized Steel.

2.2 PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers: B Line, Fee and Mason, Grinnell, Kindorf, Michigan Hanger, Unistrut, or approved equal. Grinnell figure numbers are listed below; equivalent material by other manufacturers is acceptable.

1. Note: All steel pipe supports shall have galvanized finish (Pregalvanized or hot dipped) or as called for in paragraph 2.1, B above.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.

2. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Galvanized finish.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
   a. B-Line Systems, Inc.; a division of Cooper Industries.
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.

2.6 STEEL HANGER RODS

A. Threaded both ends, threaded one end, or continuous threaded. Unthreaded rods to have galvanized finish.

B. Size rods for individual hangers and trapeze support as indicated in the following schedule. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

C. Maximum Load (lbs.)

Maximum Load (lbs.) (650 deg F Maximum Temperature)	Road Diameter (inches)
610	3/8
1130	½
1810	5/8
2710	¾
3770	7/8
4960	1
8000	1-1/4

D. Provide rods complete with adjusting and lock nuts.

2.7 FLASHING

A. Metal Flashing: per Section 07600 - Flashing and Sheet Metal.

B. Lead Flashing: 5 pounds per square foot sheet lead for waterproofing; 1 pound per square foot sheet lead for soundproofing.

C. Flexible Flashing: 47 mil thick sheet compatible with roofing.

D. Caps: Steel, 22-gage minimum; 16 gage at fire resistant elements.

2.8 SLEEVES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 24 gauge (0.70 mm) or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.

2. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.

3. Cast Iron: Cast or fabricated wall pipe equivalent to ductile iron pressure pipe, having plain ends and integral water stop, except where other features are specified.

4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with one mechanical joint end conforming to AWWA C111 and one plain pipe sleeve end.
   a. Penetrating Pipe Deflection: 5 percent without leakage.
   b. Housing: Ductile iron casting having waterstop and anchor ring, with ductile iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
   c. Pipe Sleeve: AWWA C151, ductile iron pipe.
   d. Housing to Sleeve Gasket: Rubber or neoprene push on type of manufacturer's design.

5. Cast Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

6. Underdeck Clamp: Clamping ring with set screws.

7. PVC Plastic: Manufactured, permanent, with nailing flange for attaching to wooden forms.

8. PVC Plastic Pipe: ASTM D1785, Schedule 40.

9. PE Plastic: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

2.9 SEALING AND FIRESTOPPING

A. Non-Rated Penetrations

1. Pipe Penetrations Through Below Grade Walls: In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water stop type wall sleeve.

2. Pipe Penetrations: At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade use urethane caulk in annular space between pipe insulation and sleeve.

3. Duct Penetrations:
   a. Annular space between duct (with or without insulation) and the non-rated partition or floor opening shall not be larger than 2 inches. Where existing openings have an annular space larger than 2 inches, the space shall be patched to match existing construction to within 2 inches around the duct.
   b. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4-inch sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.

B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.

C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

D. Protect insulation at all hanger points.

E. Use Stainless Steel Hangers and Materials In lieu of Galvanized steel hangers in corrosive areas.

F. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

3.2 HANGER AND SUPPORT APPLICATIONS

A. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

B. Use hangers and supports with galvanized, metallic coatings.

C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

D. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

3.3 HANGER AND SUPPORT INSTALLATION

A. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

B. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

D. Each equipment support in first paragraph below requires calculation and detail.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

G. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.4 GENERAL SUPPORT INSTALLATION

A. Install supports to provide for free expansion of the piping and duct system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

B. Coordinate hanger and support installation to properly group piping of all trades.

C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel.

Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.

D. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint, or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

3.5 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.6 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.7 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.8 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.9 FLASHING

A. Provide a flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

1. Roof flashing to be compatible with roof material. Match roof color as closely as possible.

B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.10 SLEEVES

A. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated. Grout space between sleeve and structure.

B. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, concrete floor and roof slabs, and where indicated.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast iron sleeve fittings below floor slab as required to secure clamping ring where specified.

2. Build sleeves into new walls and slabs as work progresses.

3. Install large enough sleeves to provide 1/4-inch (6 mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. PVC Pipe Sleeves: For pipes smaller than 6 inches (150 mm).
   b. Steel Pipe Sleeves: For pipes smaller than 6 inches (150 mm).
   c. Steel Sheet Metal Sleeves: For pipes 6 inches (150 mm) and larger that penetrate gypsum board partitions.
   d. Cast Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal".
      1) Seal space outside of sleeve fittings with non-shrink, non-metallic grout.

4. Except for below grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.

C. Duct Sleeves

1. Duct sleeves are not required in non-rated partitions or floors.

2. Provide sleeve required for fire dampers in fire rate partitions and floors. Reference fire damper details on drawings.

3.11 SEALING

A. Non-Rated Partitions:

1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.

2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetrations in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

END OF SECTION

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SECTION 15526

IDENTIFICATION FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Identification of all HVAC products installed under Division 15.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI/ASME: Scheme for the Identification of Piping Systems.

PART 2 - PRODUCTS

2.1 MATERIALS - IDENTIFICATION SYSTEMS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Duct Markers: Manufacturer's standard laminated plastic, color-coded duct markers. Conform to following color code:
1. Green: Cold air.
2. Yellow: Hot air.
3. Yellow/Green: Supply air.
4. Blue: Exhaust, outside, return, and mixed air.
5. For hazardous exhausts, use colors and designs recommended by ASME A13.1
6. Nomenclature: Include following:
   a. Direction of airflow.
   b. Duct service (supply, return, exhaust, etc.).

C. Plastic Equipment Markers: Laminated plastic, color coded equipment markers: Conform to following color code:
1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Blue: Equipment and components that do not meet any of the above criteria.
5. For hazardous equipment, use colors and designs recommended by ASME A13.1.
6. Nomenclature: Include following, matching terminology on schedules as closely as possible:
   a. Name and plan number.
   b. Equipment service.
7. Size: Approximately 2½ by 4 inches (65 by 100 mm) for control devices, dampers, and valves; and 4½ by 6 inches (115 by 150 mm) for equipment.

D. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, letter, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

2.2 MATERIALS - PAINT SYSTEMS

A. Acceptable Manufacturers
   1. Tnemec.
   2. Carbolene.
   3. Or equal.

B. Painting Systems
   1. Application on metal piping and pipe and equipment supports:
      a. Non-submerged, normal conditions, indoors.
      b. Generic Type: Polyamidoamine epoxy.
      c. Finish Coat: Tnemec Series 69.
      d. Interior: Two coats Series 69.
      e. Exterior: One coat Series 69, one coat Series 74.
      f. Primer Coat: Self priming.
      g. Minimum Dry Mil Thickness: 5 to 8 mil.
      h. Surface Preparation: Hand tool clean.

PART 3 - EXECUTION

3.1 GENERAL

A. Where more than one type of mechanical identification is specified for listed application, selection is installer's option, but provide single selection for each product category.

B. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 LABELING AND IDENTIFYING

A. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.

   1. Lettering Size: Minimum ¼ inch (6 mm) high lettering for name of unit where viewing distance is less than 2 feet (0.6 m), ½ inch (13 mm) high for distances up to 6 feet (1.8 m), and proportionately larger lettering for greater distances. Provide secondary lettering 1/2 to ¾ of size of principal lettering.

   2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.

B. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.

1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet (15 m).

C. Adjusting: Relocate identifying devices, which become visually blocked by work of this Division or other Divisions.

END OF SECTION

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SECTION 15562

HVAC DUCTWORK & ENGINE EXHAUST INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Ductwork insulation.

B. Emergency Generator Engine Exhaust System Insulation

C. Insulation jackets.

1.2 REFERENCES AND RELATED DOCUMENTS

A. National Fire Protection Association (NFPA):
1. NFPA 255 Building Materials, Test of Surface Burning Characteristics (ASTM E84).

B. American Society for Testing and Materials (ASTM):
1. ASTM C612 Specification for Mineral Fiber Block and Board Thermal Insulation.

C. Underwriters Laboratories (UL):
1. UL 723 Test for Surface Burning Characteristics of Building Materials

D. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

E. MICA: National Commercial and Industrial Insulation Standards (Latest Edition).

1.3 QUALITY ASSURANCE

A. Materials
1. Flame/Smoke Ratings: Provide composite insulation (insulation, jackets, coverings, sealers, mastics, and adhesives) with flamespread index of 25 or less, and smoke developed index of 50 or less as tested according to ASTM E84, NFPA 255 or by Underwriters Laboratories or other testing or inspection organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory

1.4 SCHEDULING AND SEQUENCING

A. Schedule insulation application after testing of duct systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Glass Fiber:
      a. Knauf Fiber Glass
      b. Manville
      c. Owens Corning Fiberglass Corporation
   2. Calcium Silicate:
      a. Industrial Insulation Group, LLC - Thermo 12 gold

2.2 MATERIALS

A. Type A: Flexible Glass Fiber
   1. ASTM C553 Type 1; "k" value of 0.29 at 75°F; foil scrim kraft facing with 0.02 perm rating.

B. Type B: Board
   1. ASTM C 612, Class 2, semi-rigid jacketed board "k" value of 0.23 @ 75°F; FSK facing with 0.02 perm rating.

C. Type C: Calcium Silicate Insulation
   1. Rigid Hydrous Calcium Silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs per cu. ft., thermal conductivity of not more than 0.44 at 300ºF, maximum water absorption of 90% by volume, minimum compressive strength 140 psi at 5% deformation, rated for service of 0ºF to 1200ºF. Material to be visually coded or marked to indicate it is asbestos free.

D. Adhesives
   1. Waterproof fire-retardant type produced under the UL classification and follow-up service.

E. Lagging Adhesive
   1. Fire resistive to NFPA 255 or UL 723.

F. Impale Anchors
   1. Galvanized steel, 12 gage, self-adhesive pad.

G. Joint Tape
   1. Glass fiber cloth, FSK backing.

H. Insulation Bands
   1. ¾" wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.15 inch for aluminum and .010 inch for stainless steel.

I. Tie Wire
   1. Stainless steel, 16 gage.

J. Vapor Barrier Coating
   1. Waterproof coating recommended by insulation manufacturer for outside service.

2.3 JACKETS

A. General:
   1. ASTM C 1136, except as otherwise indicated.

B. Aluminum Jacket
   1. ASTM B 209, 3003 Alloy, H-14 temper, roll stock ready for shop or field cutting and forming to indicated sizes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation
   1. Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless steel surfaces with demineralized water.

3.2 INSTALLATION

A. Refer to schedules at the end of this section for materials, forms, jackets, and thicknesses required for each ductwork system.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated ducts having surface operating temperatures below 60°F.

D. Install insulation, accessories and finishes in accordance with the latest edition of MCIA National Commercial and Industrial Insulation Standards and manufacturer's installation instructions. Exceptions to these standards will be accepted where specifically modified in these specifications or where prior written approval has been obtained from the Engineer.

E. Install insulation with smooth, straight, and even surfaces.

F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

H. Seal Ends

1. Except for flexible elastomeric insulation, taper ends at 45 deg angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.

I. Apply adhesives and coatings at manufacturer's recommended coverage per gallon rate.

J. Keep insulation materials dry during application and finishing.

K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
1. Fibrous glass ducts.
2. Factory insulated flexible ducts.
3. Factory insulated plenums, casings, terminal boxes, and filter boxes and sections.
4. Flexible connectors.
5. Vibration control devices.
6. Testing laboratory labels and stamps.
7. Access panels and doors in air distribution systems.

L. Install block and board insulation as follows:
1. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply vapor barrier tape to seal insulation in contact, open joints, breaks, punctures, and voids in insulation.

M. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:
1. Smaller Than 24 Inches: Bonding adhesive applied in 6-inch wide transverse strips on 12-inch centers.
2. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.
3. Overlap joints 3 inches.
4. Seal joints, breaks, and punctures with vapor barrier tape.

N. At test plugs, provide removable insulation plugs.

O. Insulate around damper operators so as to maintain full operating range of operator.

3.3 JACKETS

A. Foil and Paper Jackets (FSK)
1. Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1 1/2 inch laps at longitudinal joints and 3-inch wide butt strips at end joints.
2. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.

B. Install metal jacket with 2 inch overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel draw bands 12 inches on center and at butt joints.

3.4 SCHEDULE

A. Unless otherwise indicated, insulate the following duct systems:

Ductwork Type	Material	Form	Thickness (Inches)	Vapor Barrier Required	Field Applied Jacket
Interior Exposed Supply, Return & Outside Air Ducts and Plenums except in Class 1, Div 1 areas and high moisture areas. (interior transfer ductwork to remain uninsulated)	Type B Glass Fiber Board	Rect.	1½	Yes	None**
First 6' of Exhaust Duct from Exterior Wall or Roof Penetration.	Type B Glass Fiber Pipe	Round	1½	Yes	None**
	Board	Rect	1½	Yes	None**
Emergency Generator Engine Exhaust System Piping and Silencer	Calcium Silicate	Round or Block	3	No	Aluminum

*Allow for maintenance access via duct access doors.
**Utilize factory FSK (foil-scrim-kraft) jackets

END OF SECTION

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SECTION 15835

ELECTRIC HEATING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric Unit Heaters - Standard.

B. Electric Unit Heaters – Explosion Proof & Corrosion Resistant

1.2 SUBMITTALS

A. Product Data: For each Electric Heating unit, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Operation and Maintenance Data

1.3 REGULATORY REQUIREMENTS

A. Conform to applicable code for internal wiring of factory wired equipment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.5 SEQUENCING AND SCHEDULING

A. Install units (equipment exposed to finished areas) after walls and ceiling are finished and painted. Avoid damage.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS - STANDARD

A. Assembly: UL listed and labeled assembly with terminal box and cover, and built-in controls.

B. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material or exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings, as applicable.

C. Cabinet: 18 gage steel with easily removed front panel with integral air outlet and inlet grilles.

D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.

F. Motor: Horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

G. Mounting Bracket: Provide with Universal wall or ceiling bracket.

H. Control: Provide integral thermostat.

I. Provide electric unit heaters with capacities as scheduled or indicated on drawings. Acceptable manufacturers to be: Qmark type MUH unit heaters, Markel, or TPI.

2.2 ELECTRIC UNIT HEATERS - CORROSION RESISTANT AND EXPLOSION PROOF

A. Electric explosion proof unit heaters shall be INDEECO ULTRA-SAFE Series T3C, of the KW rating, voltage and phase specified in the schedule. They shall be forced fan type. Factory Mutual and CSA Approved for:

1. Class I, Divisions 1 and 2, Groups C and D; Class II, Divisions 1 and 2, Groups F and G Ignition Temperature Code No. T3C, 320°F (160°C) (standard construction).

2. Note: No substitutions allowed for this type of unit.

B. Unit heaters shall have dual automatic reset thermal cutouts for redundant over temperature protection, controlling magnetic contactor and 24 Volt control circuit transformer housed in a NEMA 7, 9 case aluminum enclosure.

C. The heat exchanger shall be liquid-to-air design, utilizing a copper tube core with integral aluminum fins. Nontoxic, inhibited, propylene glycol heat transfer fluid shall be used that provides freeze protection down to -49°F (-45°). Pressure relief valve setting to be 70 psig. The heat exchanger shall include industrial grade INDEECO electric heating elements.

D. Heat exchanger and aluminum fan blade to be enclosed in an industrial grade, corrosion resistant cabinet fabricated from epoxy-coated, 14-gauge steel. Adjustable outlet louvers to have minimum opening safety stops.

E. Fan motor shall include permanently lubricated ball bearings and built-in thermal overload protection. Motor to operate at line voltage and be prewired to the control enclosure to eliminate the need for separate field wiring to the motor.

F. The heater shall be provided with an INDEECO accessory mounting kit as applicable designed to bear the weight of the heater assembly.

G. Code C1 – 316 Stainless Steel Corrosion Resistant Construction: 316 Stainless steel heat exchanger with aluminum fins, 316 stainless steel cabinet: aluminum fan blade: cast aluminum NEMA 4X, 7,9 control enclosure: corrosion-resistant hardware: corrosion-resistant protective coated motor which has passed the ASTM B117 salt-spray test.

H. The following factory installed and prewired control options are to be supplied:

1. Adjustable built-in thermostat.

2. Disconnect switch with external handle.

3. Two position auto/fan selector switch for fan only control.

4. Pilot light

5. "Heater On" to indicate when heating elements are energized.

6. "Warning" indicates when thermal cutouts have tripped which indicates heater needs to be serviced.

PART 3 - EXECUTION

3.1 COORDINATION

A. For electric wall heaters; coordinate recessed openings in walls to accept recessed heater cabinet. Coordinate with General Contractor.

3.2 EXAMINATION

A. Verify that surfaces are ready to receive work and opening dimensions are as instructed by the manufacturer.

B. Verify that required utilities are available, in proper location, and ready for use.

C. Beginning of installation means installer accepts existing surfaces.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heaters as indicated.

C. Hang unit heaters from building structure utilizing mounting brackets. Furnish with heaters. Mount as high as possible to maintain greatest headroom unless otherwise indicated on plans.

D. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Verify that electrical wiring installation is in accordance with manufacturer's submittals and installation requirements of Division 16 sections.

3.4 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 15887

HVAC FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Sidewall Exhaust Fans – Belt Driven.

1.2 REFERENCES

A. Air Movement and Control Association (AMCA):
   1. AMCA 99 Standards Handbook
   2. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes
   3. AMCA 300 Test Code for Sound Rating Air Moving Devices
   4. AMCA 301 Method of Calculating Fan Sound Ratings from Laboratory Test Data

1.3 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions and Division 1.

   1. Product data.

   2. Operation and Maintenance Data.

1.4 QUALITY ASSURANCE - GENERAL

A. Performance Ratings: Conform to AMCA 210.

B. Sound Ratings: AMCA 301, tested to AMCA 300.

C. Fabrication: Conform to AMCA 99.

PART 2 - PRODUCTS

2.1 SIDEWALL EXHAUST FAN – BELT DRIVEN

A. Sidewall exhaust fans shall be centrifugal belt driven type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

B. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. Windbands shall have a rolled bead for added strength and shall be joined to curbcaps with a welded seam.

C. Motors shall be heavy-duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase, and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Provide with explosion proof motors as indicated on fan schedules. Motors shall be readily accessible for maintenance. Provide motor type as listed on Plan Equipment Schedules

D. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

E. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings.

F. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

G. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. The switch shall be explosion proof if the motor is explosion proof. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

H. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.

I. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

J. Provide with gravity or motor operated damper as indicated on plan equipment schedule.
   1. Damper shall be constructed of aluminum.
   2. For Corrosive applications, the damper shall be coated with same coating as the fan.
   3. For Explosive applicatons, damper shall be spark proof. If damper is motor operated, the actuator shall be suitable for the explosion proof environment.

K. Coatings: Provide one of the following coating types as indicated on fan schedule. Where no coating is listed in the schedule, provide Kynar (Custom Color) coating listed below.
   1. For corrosive applications, use Hi-Pro Polyester (Greenheck) Coating or Epoxy Phenolic (Loren Cook) coating – Grey color.
   2. "Kynar" – Organic Coating* Architectural-grade, factory applied organic coating, 70% PVDF Resin, with chrome phosphate pretreatment. Comply with AAMA 2605-98. . Color selected by Owner/Architect.

L. Fans shall be Model CWB as manufactured by Greenheck Fan Corporation, or Loren Cook Fan Company.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

B. Coordinate all wall and roof openings with General contractor. Verify final opening requirements with actual fan dimensional data.

C. Coordinate electrical requirements. Final electrical connections shall conform to Division 16 requirements. Properly ground equipment.

D. Make final electrical interlock connections between fan operation power and automatic dampers and electrical accessories provided as part of fan package.
   1. Include any necessary relays, transformers, wiring, conduit, boxes, etc as needed to make the required electrical connections. Electrical work shall conform to Division 16 requirements.
   2. Dampers shall be wired to open when fan engages and to close when fan is shut down.

END OF SECTION

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SECTION 15889

DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Work Includes

1. Ductwork
   a. Rectangular
      1) Galvanized
      2) Stainless Steel

2. Duct cleaning.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

2. ASTM A167 Specification for Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet and Strip

3. ASTM A525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process

4. ASTM A527 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Lock-Forming Quality

5. ASTM C553 Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type)

B. Underwriters Laboratories Inc. (UL)

1. UL 181 Factory-Made Air Ducts and Connectors

C. National Fire Protection Association (NFPA)

1. NFPA 90A Installation of Air Conditioning and Ventilating Systems

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

1. SMACNA Low Pressure Duct Construction Standards

2. SMACNA High Pressure Duct Construction Standards

E. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):

1. ASHRAE Handbook Fundamentals; Chapter 33 - Duct Design

2. ASHRAE Handbook Equipment; Chapter 1 - Duct Construction

1.3 DEFINITIONS

A. Duct Sizes: Inside clear dimensions as shown on plans. For lined ducts, maintain sizes inside lining.

B. Low Pressure Ductwork: Up to 2 inch WG positive or negative pressure and velocities less than 2,500 FPM.

1.4 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts, Stainless Steel where installed on stainless steel ducts.

C. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.

D. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq ft for each side in conformance with ASTM A90.

E. Stainless Steel Ducts: ASTM A167, Type 304, 2 gauges heavier than standard galvanized ductwork. (In lieu of stainless steel, rigid fiberglass ductwork can be substituted pending approval of the engineer.)

F. Fasteners: Rivets, bolts, or sheet metal screws. Use stainless steel fasteners on stainless steel ducts.

G. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

I. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded. Stainless steel in areas where stainless steel duct is used.

2.2 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded stainless steel rod. Note: All Hanger material shall be either Galvanized or stainless steel. No bare steel hangers will be accepted.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.

2.4 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.

2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Nexus Inc.
   c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Lockformer.

2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.

3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359-inch-thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.5 ROUND DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock -Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Duct Joints:

1. Ducts up to 48 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

D. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

E. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

F. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
   a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.

3. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

4. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

5. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

6. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

7. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040-inch-thick with 2-piece welded construction.

8. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

2.6 GENERAL

A. Construct Ts, bends, and elbows with radius of not less than 1-½ times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

B. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

C. Elbows and transformation pieces, etc., shall be one to two gauges heavier, depending on size. Ratio of width individual air passages to total width of elbow shall be one (1) to five (5).

D. Longitudinal joints in horizontal runs or in risers shall be made with grooved seams. In elbows and transformation pieces, they shall be made with Pittsburgh corner seams or double corner seams.

E. Bracing shall be galvanized steel or stainless steel angles as applicable and conform to SMACMA recommendations and standards.

F. All ductwork shall be constructed in accordance with SMACNA and ASHRAE Specifications Standards and in accordance with state and local code requirements. Ductwork to be sealed in accordance with SMACNA seal Class B.

G. Provide fire resistant neoprene or other approved flexible connections on the entering and leaving side of all air handling units, etc., and at the collection boxes of all roof fans, etc., or as shown on plans, equal to Ventfabric "Ventglas". Attach with metal collar frames to prevent air leakage.

H. Provide flexible connection for ducts of dissimilar metals to prevent galvanic action.

I. Use double nuts and lock washers on threaded rod supports.

PART 3 - EXECUTION

3.1 SERVICE

A. Ductwork systems serving and/or located in Class 1, Division 1 areas, high moisture and/or corrosive areas to be stainless steel and/or as noted on the drawings.

3.2 INSTALLATION

A. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

C. Suspended horizontal ductwork shall be securely and rigidly anchored and supported from the building structure by means of rod-angle iron or strap iron hangers. Rod hangers shall be threaded at both ends and equipped with nuts and washers. Angle and straphangers shall be attached to ducts by means of welds or sheet metal screws or by rivets. They shall be attached to suitable roof or ceiling structures through formed angles, by anchor screws and heavy, wide washers. If attached to floor slab, the bearing quality of slab material shall be checked and found capable of supporting weight of duct.

D. Vertical dust risers shall be rigidly supported as they pass through floors, ceilings or roofs by angle iron spanning the opening and firmly and securely attached to the building walls or columns. All ductwork shall be so installed as to be free from vibration under all normal operating conditions. Where required, suitable sound attenuators shall be incorporated with the anchors and/or supports. Finish openings in floors, walls and ceilings with 22-gauge sheet metal closures to give a neat appearance.

E. Where ducts pass through walls or floors, provide a suitable sheet metal angle around the periphery of the duct. Where ducts pass through exterior building construction, provide a suitable flashing and counterflashing to make a weathertight installation.

F. Where external insulated ducts pass through walls, floors or ceilings, suitable size openings shall be made to allow for the insulation through the opening. The insulation shall not be stopped on each side of the opening.

G. Connect diffusers to low pressure ducts with 5 feet maximum length of flexible duct. Hold in place with strap or clamp.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual". Provide evidence of compliance upon request.

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.

4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.4 ADJUSTING AND CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment, which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

SECTION 15891

DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes:

1. Volume dampers.

2. Motorized control dampers & Actuators.

3. Turning vanes.

4. Duct-mounting access doors.

5. Flexible connectors.

6. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Motorized control dampers and damper motors.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide accessories suitable for environment in which they are being installed. Match duct material where applicable, i.e., for stainless steel ductwork, use stainless steel duct accessories.

2.2 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.

2. American Warming and Ventilating.

3. McGill AirFlow Corporation.

4. METALAIRE, Inc.

5. Ruskin Company.

6. Vent Products Company, Inc.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade

dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.

3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

4. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.

5. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 MOTORIZED CONTROL DAMPERS – PROVIDED AS STAND ALONE NOT PART OF EQUIPMENT PACKAGE.

A. Manufacturers

1. TAMCO Series 9000 ECT (Insulated w/ thermally broken frame) & Series 1000 (Uninsulated).

2. Arrow Series AFDTI-25LT (Insulated w/ thermally broken frame) & Series ADF-20 (Unsulated)

B. Insulated dampers shall be as follows:

1. Extruded aluminum damper frame shall not be less than .080" thickness. Damper frame to be 4" deep and shall be insulated with polystyrene on three sides if “Installed to Duct” type and on four sides if “Flanged to Duct” type.

2. Blades to be extruded aluminum, internally insulated with non-CFC, expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R 2.29 and a temperature index of 55.

3. Blade gaskets shall be Flexible silicon. Frame seals shall be of extruded flexible silicon. Gaskets to be secured in an integral slot within aluminum extrusions.

4. Bearings to be comprised of a clean inner bearing fixed to a 7/16" aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in frame.

5. Linkage hardware shall be installed in frame side and be constructed of aluminum and corrosion resistant zinc and nickel plated steel, complete with cup point trunnion screws for slip proof grip.

6. Dampers to be designed for operation in temperatures ranging between 40ºF and 212ºF.

7. Damper shall be available with either opposed blade action for modulating control or parallel blade action for basic open/close control. See damper schedule for Action specified.

8. Air leakage through a 48" x 48" damper shall not exceed 4.12 cfm/sq. ft. against 4" w.g. differential static pressure @ standard air leakage data to be certified under the AMCA certified ratings program.

9. Leakage shall not exceed 6.7 cfm/sq. ft. against 4" differential static pressure @ 40ºF.

10. Pressure drop of a fully open 48" x 48" damper shall not exceed .03" w.g. at 1,000 fpm.

11. Dampers shall be made to size required without blanking off free area.

12. Dampers shall be “Flanged to Duct” configuration.

13. Installation of dampers shall be in accordance with manufacturer’s installation guidelines.

C. Uninsulated dampers to be as follows:

1. Extruded aluminum damper frame shall not be less than .080” thick. Damper frame to be 4” deep.

2. Blades to be of extruded aluminum profiles.

3. Blade gaskets shall be of extruded EPDM. Frame seals shall be of extruded TPE. Gaskets to be secured in an integral slot within aluminum extrusions.

4. Bearings to be comprised of a celcon inner bearing fixed to a 7/16" stainless steel hexagon blade pin rotating within a polycarbonate outer bearing inserted in frame.

5. Linkage hardware shall be installed in frame side and be constructed of stainless steel, complete with cup point trunnion screws for slip proof grip.

6. Dampers to be designed for operation in temperatures ranging between -40ºF (-40ºC) and 212ºF (100ºC).

7. Dampers shall be available with either opposed blade action for modulating control or parallel blade action for basic open/closed control.

8. Air leakage through a 48" x 48" damper shall not exceed 10.3 CFM/sq. ft. against 4" W.G. differential static pressure @ standard air. Standard air leakage data to be certified under the AMCA certified ratings program.

9. Pressure drop of a fully open 48" x 48" damper shall not exceed .02" W.G. at 1000 FPM.

10. Dampers shall be made to size required without blanking off free area.

11. Dampers shall be "Flanged to Duct" configuration.

12. Installation of dampers shall be in accordance with manufacturer's installation guidelines.

13. Provide damper with scheduled coatings.

D. Damper Motors / Actuators

1. Provide damper motors/actuators of the electronic type sized to operate their respective dampers with sufficient reserve power to provide smooth modulation action.

2. Provide damper operators with spring return, which shall return all dampers to their normally open or normally closed positions upon failure of controlling signal. Dampers shall be 120V type with end switches for proof of open and/close.

3. In corrosive areas, provide damper motor enclosure suitable for use in corrosive atmosphere. In Class 1, Division 1 & 2 areas, provide damper motors with enclosures which are both corrosion resistant and explosion proof.

4. Manufacturers:
   a. Belimo Aircontrols, Inc.
   b. Honeywell
   c. Johnson Controls

2.6 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Duro Dyne Corp.
   c. METALAIRE, Inc.
   d. Ward Industries, Inc.

2.7 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, insulated, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers:
   a. American Warming and Ventilating.
   b. CESCO Products.
   c. Ductmate Industries, Inc.
   d. Greenheck.
   e. McGill AirFlow Corporation.
   f. Ventfabrics, Inc.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Provide number of hinges and locks as follows:
   a. Less Than 12 Inches Square: Secure with two sash locks.
   b. Up to 18 Inches Square: Two hinges and two sash locks.
   c. Over 18": full length piano hinge with no less than two sash locks.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Ductmate Industries, Inc.

2. Duro Dyne Corp.

3. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.

2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F.

2.9 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers (powered backdraft dampers) on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers for all diffuser and equipment connections unless noted otherwise.

F. Provide additional balancing dampers that are required to achieve a balanced system but not shown on the drawings. Install balancing dampers a minimum of two duct widths from branch takeoff.

G. Provide test holes at fan inlets and outlets and elsewhere as indicated.

H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. Where shown on plans.

2. On both sides of duct coils.

3. Downstream from volume dampers, turning vanes, and equipment.

4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.

5. On sides of ducts where adequate clearance is available.

I. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

J. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

K. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 15936

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Registers/grilles.

2. Louvers.

1.2 REFERENCES

A. National Fire Protection Association (NFPA):

1. NFPA 90A Installation of Air Conditioning and Ventilating Systems.

B. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1. SMACNA Low Pressure Duct Construction Standard.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with the Section 01300.

1.4 REGULATORY REQUIREMENTS

A. Conform to NFPA 90A.

PART 2 - PRODUCTS

2.1 CONTRACTOR FABRICATED – PLAN DESIGNATION “A”

A. Stainless steel screen – 1” x 1” size fabricated with minimum 1-1/4” stainless steel borders.

B. Contractor option to utilize a manufactured equivalent. Requires pre-approval.

2.2 LOUVERS

A. Standard Louvers

1. Provide 4-inch deep louvers with K style blades on 37 deg & 45 deg angles, heavy channel frame, birdscreen with ¾ inch screen.

2. Fabricate of 0.081" thick extruded 6063T5 aluminum alloy, welded assembly.

3. Finish: “Kynar” - Organic Coating * Architectural-grade, factory-applied organic coating, 70% PVDF Resin, with chrome phosphate pretreatment. Comply with AAMA 2605-98. Final “custom color” selection by Owner/Architect.

4. Provide louvers with Extended Sill

5. Provide louvers of sizes as indicated on plans.

6. Acceptable Manufacturers: Greenheck ESK-402, or Ruskin Equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

C. Install grilles to ductwork with airtight connection.

D. Provide balancing dampers on duct take-off to grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

END OF SECTION

SECTION 15971

HVAC ELECTRIC CONTROL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

A. This Section includes Electric control systems which are to serve the following Structure:

1. Structure 30 – Lift Station

B. HVAC Controls will be a field mounted controls.

1.2 DESCRIPTION OF WORK

A. Extent of electric HVAC control systems work required by this section is indicated on drawings and schedules, by requirements of this section, related sections.

1. Control system components

2. Control sequences are specified in this section.

B. Provide the following electrical work as work of this section, complying with requirements of Division 16 sections:

1. Control wiring between field-installed controls, indicating devices, and unit control panels. All control wiring to be routed in conduit and shall comply with Division 16 requirements. Coordinate with Electrical Contractor.

2. Power supply wiring for power source to power connection on controls and/or unit control panels unless shown on electrical drawings.

3. Interlock wiring between electrically operated equipment units; and between equipment and field-installed control devices unless shown on electrical drawings.

4. Any control required for a fully functional HVAC system per the Sequence of Operation outlined here-in which shall be provided as part of this Section. The end result shall be a fully functional HVAC control system.

1.3 RELATED SECTIONS

A. Control dampers and damper actuators which are provided as stand-alone units are specified in Section 15891 – Duct Accessories.

B. All related Division 16 sections.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms specializing and experienced in electric control system installations for not less than 5 years.

C. Codes and Standards:

1. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.

2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

3. NFPA Compliance: Comply with NFA 90A "Standard for the installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.5 SUBMITTALS

A. Submittal Coordination: HVAC Controls Submittals shall be coordinated and reviewed by the Process Controls System Integrator. The System Integrator shall review for Coordination and Approve the submittals before they are submitted to the Engineer for Review.

B. Product Data

1. Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

2. Coordination items between the HVAC Controls Contractor and the Systems Integrator shall be clearly shown as part of the submittals. Items provided by the system Integrator shall be indicated. Also indicate responsibility for installation of coordinated components.

C. Shop Drawings

1. Submit shop drawings for each HVAC electric control system:
   a. Schematic flow diagram of system showing fans, dampers, equipment and control devices.
   b. Clearly show work installed under this section and tie-ins and control supplied/furnished by Process Instrumentation & Controls Contractor.
   c. Label each control device with setting or adjustable range of control.

d. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
e. Provide details of faces of control panels, including controls, instruments, and labeling.
f. Include written description of sequence of operation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

1. Component manufacturer shall be generally as listed below:
   a. Siemens
   b. Johnson Controls
   c. Honeywell

2. Some individual component manufacturers may vary. These may be listed separately with the component descriptions.

2.2 MATERIALS AND EQUIPMENT

A. General

1. Provide electric control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, sensors, controllers, contactors, low voltage transformers, and other components as required for a complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide electric control systems with following functional and construction features as indicated.

2. Hazardous and Corrosive Environments: Provide electric control systems suitable for corrosive and/or Class I, Division 1 or 2 (explosion proof) environments. Coordinate these with other work in the associated areas and with Division 16 work. Use proper NEMA rated panels, boxes, devices, etc., & utilize proper materials.

B. Remote-Bulb Thermostats: Provide remote-bulb thermostats of on-off, or modulating type, or reverse acting as required by sequence of operation. Provide liquid-filled units designed to compensate for changes in ambient temperature at instrument case. Provide capillary and bulb of copper or stainless (corrosion resistant where required). Equip bulbs in water lines with separate wells of same material as bulb. Support and protect capillary & bulbs by installing in thru conduit.

1. Provide scale settings and differential settings where applicable, which are clearly visible and adjustable from front of instrument.

2. Equip on-off remote-bulb thermostats with precision snap switches, and with electrical rating as required by application.

3. Provide modulating remote-bulb thermostats of potentiometer type constructed so that complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

2.3 MISCELLANEOUS

A. Timers/Timing Relays: Plug in type, adjustable with timing range as required.

B. Electronic Sensors General: Provide electronic temperature sensors of supersensitive resistance type, which are vibration and corrosion-resistant, and of wall mounted immersion, duct mounting, averaging or bulb type as required for application.

C. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

1. Thermistor temperature sensors as follows:
   a. Accuracy: Plus or minus 0.5 deg F at calibration point.
   b. Wire: Twisted, shielded-pair cable.
   c. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
   d. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

D. Electric Contactors

1. Provide contactors for operating or limit-control of electric heating loads, which are UL-listed for 100,000 cycles of resistive loads. Equip with replaceable molded coils and replaceable silver cadmium oxide contacts. Coat core laminations with heat-resistant inorganic film to reduce core losses. Provide line and load terminals on contactors with higher-than-35-amp rating, or provide one-piece formed-and–welded pressure type. Provide screw-type contactors for 35-amp-or-lower rating. Equip field-mounted contactors with suitable steel enclosures; and provide open-type mounting for those installed in factory-fabricated panels.

E. Local Control Panels

1. Provide control panels with suitable brackets for either wall or floor mounting and proper NEMA rating for location, for each supply fan and miscellaneous control system. Locate panel adjacent to systems served.
   a. Match NEMA rating and material of panel construction with panels provided by Division 16 work in each space. Coordinate with Division 16 contractor.

b. Utilize minimally sized panels for application. Overly large panels with large amount of empty space will be rejected and will require the contractor to replace with acceptable size.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 SEQUENCE OF OPERATION

A. Structure 30 - Lift Station

1. Generator Rm - 101
   a. Electric unit heater 30-EUH-03 to be controlled by Integral thermostat.
      1) On a call for heat, the unit is to cycle on to heat the space.
      2) When the space heating requirements are satisfied, 30-EUH-03 is to cycle off.
   b. Motorized damper 30-D-02 & 03 at Louver 30-L-02 & 03 to be controlled by "ON-OFF-AUTO" switch with reverse acting thermostat.
      1) In the "ON" position, damper 30-D-02 & 03 to open.
      2) In the "OFF" position, damper 30-D-02 & 03 is to close.
      3) In the "AUTO" position, damper to be controlled by a reverse acting thermostat with remote sensing bulb at room ceiling. Thermostat setpoint at 90ºF (adjustable). When temperature is above setpoint, damper 30-D-02 & 03 are to open. When the temperature is below setpoint, damper 30-D-02 & 03 is to close.
   c. Damper 30-D-02 & 03 to be interlocked to emergency generator control.
      1) This interlock operation shall override any control listed above.
      2) When the emergency generator engages, all of the dampers are to open.
      3) When the generator is OFF, the dampers are to be closed and revert back to "ON-OFF-AUTO" switch control outlined above.
      4) Coordinate interlock with emergency generator supplier.

2. Pump Room - 102
   a. Electric unit heater 30-EUH-01 & 02 to be controlled by integral thermostat.
      1) Units are to cycle on/off as required to maintain temperature setpoint.
   b. Exhaust Fan 30-EF-01 to be controlled by Manual "On-Off" push botton switch with green run pilot light located outside of entrance double doors. Switch Panel to be NEMA4X stainless steel.
      1) Exterior switch to have a pilot light indicating exhaust fan operation.
      2) Once started, exhaust fan 30-EF-01 shall have an adjustable timeout function to shut down the fan automatically once it is started. The

time range shall be adjustable from 0-60 minutes. (Initial setting should be 15 minutes.) If the Exterior Switch is manually switched off, the timer shall reset for the next "ON" event.

3) Interlock manual switch and timer with room lights.

3.3 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

A. General

1. Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications. Mount controllers at convenient locations and heights. Provide working HVAC control system utilizing industry standard electric control devices and as specified. Finished Controls shall operate HVAC equipment as Control sequences call for.

2. Install local control panels for equipment as listed and install per Division 16 requirements.

B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.

C. Wiring System: Install complete control wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system. Also label all remote control devices with identification consistent with shop drawing and maintenance manuals.

E. Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers; automatic duct heater resets may, at Contractor's option, be installed in interlock circuit of power controllers.

F. Unit-Mounted Equipment: Where control devices are indicated to be unit-mounted, ship electric relays, electric switches, valves, dampers, and damper motors to unit manufacturer for mounting and wiring at factory.

G. Provide accessories such as mounting brackets, fasteners, supports, etc. which are compatible with environment where devices will be located. In corrosive environments use stainless steel materials.

H. Provide electrical contactors for automatic operation of equipment where needed when magnetic starters are not furnished as part of the design.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 16

B. Install building wire and cable according to Division 16

C. Install signal and communication cable according to Division 16

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.

2. Install exposed cable in raceway.

3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, and electrical connections.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.

3. Calibration test electric controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

B. Engage a factory-authorized service representative to perform startup service.

C. Replace damaged or malfunctioning controls and equipment.

1. Start, test, and adjust control systems.

2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.

3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.6 ADJUSTING AND CLEANING

A. Start-UP

1. Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Cleaning

1. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Final Adjustment

1. After completion of installation, adjust thermostats, control valves, motors, and similar equipment provided as work of this section, verify control sequence operation. Provide verification documentation.
   a. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3.7 CLOSEOUT PROCEDURES

A. Owner's Instructions

1. Provide services of manufacturer's technical representative for two separate 4-hour days to instruct Owner's personnel in operation and maintenance of electric control systems. The first training session shall be an initial overview with enough information for the Owner to understand the functionality, adjustment capability, etc. A subsequent follow-up training session is to take place with the owner after the owner has spent time using the controls and has a chance to develop additional questions, etc…

2. Schedule instruction with Owner; provide at least 7-day notice to Contractor and Engineer of initial training date. The follow-up training date shall be coordinated with the Owner.

END OF SECTION

SECTION 15990

HVAC SYSTEM TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Air Handling Systems:
   a. HVAC Fans – Exhaust/Supply & Transfer fans & fan ductwork systems
   b. Damper interlocks
   c. HVAC Equipment/Control interlocks – HVAC Controls Commissioning

2. HVAC equipment quantitative-performance settings.

3. HVAC Control System Commissioning: Verify that Automatic Control Systems & Devices are functioning properly.

4. Reporting results of activities and procedures specified in this Section.

1.2 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Balancing Devices: All installed devices necessary to achieve proper balancing of the system such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers.

D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. Report Forms: Test data sheets for recording test data in logical order.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. TAB: Testing, adjusting, and balancing.

K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

L. Test: A procedure to determine quantitative performance of systems or equipment.

M. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.3 SUBMITTALS

A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

1.4 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. TAB Conference: Meet with Owner and Engineer's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
   a. Submittal distribution requirements.
   b. The Contract Documents examination report.
   c. TAB plan.
   d. Work schedule and Project-site access requirements.
   e. Coordination and cooperation of trades and subcontractors.
   f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.5 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions.

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Verify that balancing devices are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

2. The TAB Firm shall review the Contract Documents and the Mechanical Contractor's shop drawings to identify any additional balancing devices that are necessary to achieve a balanced system but not shown on the drawings. Furnish and install those additional balancing devices necessary to achieve a balanced system. Coordinate with the Mechanical Contractor to properly schedule this work. Failure to coordinate installation of these devices with the Mechanical Contractor will result in absorbing all costs associated with work of other trades that is affected by modification of building components and systems. All balancing devices and installations shall comply with other Division 15 sections.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine automatic temperature system components to verify the following: Dampers, valves, and other controlled devices are operated by the intended controller.

1. Dampers and valves are in the position indicated by the controller.

2. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.

3. Sensors are located to sense only the intended conditions.

4. Sequence of operation for control modes is according to the Contract Documents.

5. Controller set points are set at indicated values.

6. Interlocked systems are operating.

7. Changeover from heating to cooling mode occurs according to indicated values.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.

2. Automatic temperature-control systems are operational.

3. Equipment and duct access doors are securely closed.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.

3. Motor rpm.

4. Efficiency rating.

5. Nameplate and measured voltage, each phase.

6. Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.5 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.6 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Heating-Water Flow Rate: +5 to minus 5 percent.

2. Air Flow Rate: +5 to minus 5 percent. Adjust air flows to maintain relative room pressure requirements. Hazardous, corrosive and high moisture areas should always be set so that relative room pressure is negative in relationship to adjacent areas and rooms.

3.7 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.8 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Fan info and test data

2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.

2. Name and address of TAB firm.

3. Project name.

4. Project location.

5. Engineer's name and address.

6. Contractor's name and address.

7. Report date.

8. Signature of TAB firm who certifies the report.

9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

10. Summary of contents including the following:

11. Indicated versus final performance.

12. Notable characteristics of systems.

13. Description of system operation sequence if it varies from the Contract Documents.

14. Nomenclature sheets for each item of equipment.

15. Data for terminal units, including manufacturer, type size, and fittings.

16. Notes to explain why certain final data in the body of reports varies from indicated values.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Air flow rates –fans.

2. Fan Test Data (Indicated and Actual Values):
   a. Voltage at each connection.
   b. Amperage for each phase.
   c. Air flow rate in cfm

3.9 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.

2. Randomly check the following for each system:
   a. Verify that balancing devices are marked with final balance position.
   b. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.

2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.

3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.10 TEST ALL HVAC CONTROL SYSTEMS FOR PROPER OPERATION (HVAC CONTROL SYSTEM COMMISSIONING).

A. Test thermostats for proper operation.

B. Test all interlocks between equipment and control devices. Verify fan equipment operates and dampers open and close automatically as required.

C. Verify proper operation of makeup air unit along with any associated interlocks, air quality sensors & timing/timeclock functions as applicable.

D. Report any deficiencies in HVAC Control to HVAC Contractor and his Control Subcontractor for corrective action. Recheck for proper operation after corrections are made.

E. Provide summary of results of this control system checkout as part of tab report. State findings for each system checked – whether operation complies with sequence of operation or not and describe corrective action taken by HVAC contractor and results of retest.

3.11 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Include additional tests which could be requested by the engineer as part of startup and system adjusting. These additional tests shall be included as part of the original project scope.

C. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern Work under this Section.

1.2 DEFINITIONS

A. The Owner: the City of South Milwaukee.

B. The Engineer: Applied Technologies, Inc., Brookfield, Wisconsin.

C. Provide: Furnish, install and wire complete and ready for service.

D. Exposed: Exposed to view in any room, corridor or stairway.

E. Code: National, State and Local Electrical codes including OSHA requirements.

F. NEC: National Electrical Code

G. NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities

H. Signal Voltage: NEC class 1, 2, or 3 remote control, signaling, or power limited circuits.

I. Low Voltage: 50 to 600 volts

J. Medium Voltage: 601 to 35,000 volts

K. Electrical Ductbank: Assembly consisting of electrical conduits encased in concrete.

1.3 STANDARDS AND CODES

A. All work shall be installed in accordance with National, State, and Local codes, ordinances, laws, and regulations. National Codes include, but are not limited to, the NEC and NFPA 820. Comply with all applicable OSHA regulations.

B. All materials shall have a UL or ETL label where a UL or ETL Standard and/or test exists.

1.4 DIMENSIONS AND DEFINITE LOCATIONS

A. The drawings depicting electric work are diagrammatic and show, in their approximate location, symbols representing electrical equipment and devices. The exact location of

such equipment and devices shall be established in the field in accordance with instructions from the Engineer and/or as established by manufacturer's installation drawings and details.

B. The Contractor shall refer to shop drawings and submittal drawings for all equipment requiring electrical connections to verify rough-in and connection locations.

C. Unless specifically stated to the contrary, no measurement of an electric drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the electric drawings are subject to measurements of adjacent and previously completed work. All measurements shall be performed prior to the actual installation of equipment.

1.5 DRAWINGS

A. The Contractor shall keep a detailed up-to-date record, of the manner and location in which all installations are actually made, indexing each feeder, pull box and protective device.

B. As Built Drawings - See General Requirements - Division 1.

C. In the event of a conflict between the drawings and specifications, Contractor shall base their bid on the greater quantity, cost or quality of the item in question, unless such conflict is resolved by an addendum.

1.6 SHOP DRAWINGS AND EQUIPMENT BROCHURES

A. Submit to Engineer for review, the manufacturer's shop drawings and/or equipment brochures in accordance with Division 1 for the following:
1. Section 16011 – Electrical Studies Report
2. Section 16111 - Conduits
3. Section 16112 - Conduit Fittings
4. Section 16120 - Low Voltage Wires, Cables, & Connectors
5. Section 16130 - Boxes
6. Section 16140 - Wiring Devices
7. Section 16170 - Motor and Circuit Disconnects (Include disconnect overcurrent devices with this submittal)
8. Section 16421 - Surge Protective Devices
9. Section 16450 - Ground rod locations and measured resistance
10. Section 16461 - Low Voltage Dry Type Transformers
11. Section 16470 - Electrical Panelboards (Include panelboard overcurrent devices with this submittal)
12. Section 16475 – Low Voltage Overcurrent Protective Devices
13. Section 16483 – Adjustable Frequency Drives
14. Section 16510 - Lighting Fixtures
15. Section 16621 - Automatic Transfer Equipment

B. Plans - Lighting Control Contactors, Lighting Control Time Clocks, Lighting Control Photocells

C. Shop drawings shall be submitted in advance of construction and installation so as to not cause delay in other Contractor's work.

1.7 TESTS AND ACCEPTANCE

A. The operation of the equipment and electrical systems does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.

B. After the work is completed and prior to acceptance, the Contractor shall conduct the following tests, tabulate data, date, sign and submit to the Engineer:
1. Standard megger insulation test on each feeder.
2. Ground resistance test.
3. Clamp ammeter test on each feeder conductor with all utilization equipment energized. The load current in each phase conductor of the feeder or the portion thereof supplying the panel shall not differ from the average connected load currents in the feeder conductors by more than 7½%. If the load current does differ by more than 7½%, the Contractor shall change phase loading to same or receive written approval from the Engineer that this is not required due to the nature of the load.

C. Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction. The Contractor shall demonstrate that all work is complete and in perfect operating condition, with race way and conduit system properly grounded, all wiring free from grounds, shorts, and that the entire installation is free from any physical defects.

D. In the presence of the Engineer and the Owner, the Contractor shall demonstrate the proper operation of all miscellaneous systems.

E. Perform other tests as specifically directed in other sections of the specification for specific equipment.

1.8 IDENTIFICATION

A. Each distribution and lighting panel shall be equipped with a typewritten directory describing the loads served. Directory shall be contained in a steel frame mounted on the inside face of the panel's door and shall be covered with a sheet of clear plastic.

B. All distribution panels, transformers, transfer switches, panels and cabinets shall be provided with 1/8" minimum thickness 5 ply lamecoid plastic nameplates indicating usage, plan designation and voltage where applicable. This identification may be on the exterior of the unit. Nameplates shall be white with black engraved lettering. Lettering shall be ½" high minimum. Fasten nameplates with escutcheon pins.

C. All panelboards and control panels shall include a warning label indicating the risk of Arc Flash. The warning label shall comply with N.E.C. article 110.16 and O.S.H.A. 29.

D. Junction and pull boxes shall be stenciled as follows:

1. Lighting and power feeders and branch circuits - 120, 208, 240, 277, and 480V.
2. Instrumentation & Control - I&C

E. Branch wiring shall be color coded per industry standards. Where wires of different systems junction in a common box each cable shall be grouped with its own system and identified using tags or identification strips.

F. On all 3 phase systems, each phase shall be identified at all terminals using code marker.

G. All cover plates for control stations controlling remote equipment shall be engraved to identify the device being controlled.

H. All motor starters, remote control stations, etc., shall be identified with engraved lamecoid nameplates fastened to the equipment with escutcheon pins. Nameplates shall be 1/8" 5 ply lamecoid with 1/2" black letters on a white background. Adhesive cloth labels, similar to those manufactured by Brady Label Co., may be used on motor switches and controls only, indicating the number, designation, size and usage of the motor.

I. Refer to individual specification sections for more specific or additional identification requirements.

1.9 CORROSIVE AREAS

A. Refer to drawings for areas that are designated corrosive.

1.10 HAZARDOUS AREAS

A. NFPA 820 identified NEC-Area Electrical classifications. The Contractor shall provide material and installation in compliance with this national standard.

B. All sanitary sumps and wastewater wet wells have a CLASS 1, DIVISION 1 area rating. Contractor shall provide material and installation labor accordingly.

1.11 FIRESTOPPING

A. Openings in fire rated construction and annular spaces around conduits, cable trays, and other penetrating items shall be protected in accordance with NEC article 300-21 and in accordance with the Wisconsin Administrative Code, Department of Commerce Chapter 51.049. The fire rating of the protective seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the construction is maintained.

B. Firestopping materials shall include, but not be limited to, mortars, sealants and caulks, putties, collars, intumescent wrap strips mastics, and firestop pillows. All materials and methods used shall be recognized by an independent testing agency and shall have flame and temperature ratings assigned by that agency.

C. Materials using solvents or those requiring hazardous waste disposal shall not be used.

D. All wall or floor penetrations openings shall be as small as possible.

E. All openings and annular spaces required by code to be protected, shall be protected whether specifically indicated on the plans or not.

F. The firestop assemblies shall meet ASTM E-814 and all of the fire test and hose stream test requirements of an independent testing agency.

G. Installation of materials and assemblies shall be in strict accordance with the manufacturer's instructions.

H. Acceptable Manufacturers
   1. 3M Corporation.
   2. Nelson Firestop Products
   3. Rectorseal Corporation

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

A. Not used.

END OF SECTION

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SECTION 16011

ELECTRICAL STUDIES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. The contractor shall retain the services of an independent third party firm to perform a short circuit study, a protective device coordination study, and arc flash study.

B. The studies shall be submitted to the Design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval from the Engineer may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

C. The studies shall include all portions of the electrical distribution system from the normal power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

D. The firm should be experienced 480 Volt power system evaluations. The studies shall be performed, stamped and signed by a registered professional engineer in the State of Wisconsin. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Engineer for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.

E. The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.3 DATA COLLECTION FOR THE STUDIES

A. The contractor shall collect and provide the required data for preparation of the studies. The Engineer performing the system studies shall furnish the Contractor with a listing of the required data immediately after award of the contract.

B. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

C. The Contractor is warned against the use of default generic device/equipment values that are available from the analysis software. Instead, the Contractor's study shall use project-specific device data.

1.4 SUBMITTALS

A. Third party qualifications. Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies.

B. Draft report. Submit a draft of the study to Engineer for review prior to delivery of the study to the Owner.

C. Final study report.
1. Make all additions or changes as required by the reviewer.
2. Provide studies in conjunction with equipment submittals to verify equipment ratings required.
3. The results of the power system study shall be summarized in final reports. Six (6) bound sets of the final report shall be submitted.

D. The report shall include the following sections:
1. Field study findings.
2. Descriptions, purpose, and scope of the study.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding same.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
5. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
6. Print-out of the Arc-Flash labels to be applied to all equipment identified by NFPA-70E.
7. List of software input data (values), including but not limited to generator sub-transient reactances.

1.5 POWER COMPANY APPROVAL

A. Where required, copies of the final report shall be submitted to the power company for their review and Approved copies of the report shall be submitted to the Design Engineer.

1.6 QUALITY ASSURANCE

A. Reference standards listed in the IEEE Standard 242 "Buff Book", latest edition.

B. Reference the equipment requiring Arc-Flash labeling in Article 400 of NFPA-70E.

C. The short circuit study shall be performed with the aid of a computer program and shall be In accordance with the latest applicable IEEE and ANSI standards.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 SHORT CIRCUIT STUDY AND PROTECTIVE DEVICE COORDINATION STUDY

A. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, low voltage switchgear lineup, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault currents.

B. In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

C. Include on the curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.

D. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.

E. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and

protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.

F. Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on Drawing one-lines.

G. Utilize equipment load data for the study obtained by the Contractor from Contract Documents, including Contract Addendums issued prior to bid openings.

H. Include fault contribution of all motors in the study. Notify the Engineer in writing of circuit protective devices not property rated for fault conditions.

I. Include phase and ground coordination of the standby generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

J. Evaluate proper operation of the ground relays when a generator exists, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.

K. For motor control circuits, show the combined current plus symmetrical and asymmetrical of the largest motor starting current to ensure protective devices will not trip major or group operation.

3.2 ARC FLASH HAZARD ANALYSIS/STUDY

A. The arc flash hazard analysis shall be performed to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchgear, panelboards, busway and splitters) where work could be performed on energized parts.

C. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum

contribution from the utility and will assume the maximum amount of motors to be operating.

F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

G. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

H. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

I. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy to the corresponding location.

J. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

K. The Contractor shall affix each Arc-Flash label to the appropriate equipment, following approval of the ELECTRICAL STUDIES submittal.

3.3 ELECTRICAL STUDIES OUTLINE:

Table of Contents for Lift Station:

I. Overview
II. Short Circuit Study
- SC-1. Purpose
- SC-2. Explanation of Data
- SC-3. Assumption(s)
- SC-4. Analysis of Results
- SC-5. Recommendations
- SC-6. DAPPER Fault Analysis Input Report

SC-7. DAPPER Fault contribution Complete Report
- WWTF Normal Operation (Generator Off)
- WWTF Emergency Operation (Generator On)

III. Protective Device Coordination Study
PDC-1. Purpose
PDC-2. Explanation of Data
PDC-3. Assumption(s)
PDC-4. Analysis of Results
PDC-5. Recommendations
PDC-6. CAPTOR Results – Existing
PDC-7. CAPTOR Results – With All Recommendations
PDC-8. Example Station

IV. Arc Flash Hazard Study
ARC-1. Purpose
ARC-2. Explanation of Data
ARC-3. Assumption(s)
ARC-4. Analysis of Results
ARC-5. Recommendations
ARC-6. SKM Arc Flash Evaluation Report – Existing
- WWTF Normal Operation (Generator Off)
- WWTF Emergency Operation (Generator On)
ARC-7. SKM Arc Flash Evaluation Report – With All Recommendations
ARC-8 Print-out of all Arc-Flash Labels

V. Prioritized Recommendations and Calculations

VI. Appendices
APP-1 Input Data (collected from devices and equipment)
APP-2. DAPPER One-Line Diagram – Existing
APP-3. DAPPER One-Line Diagram – With All Recommendations
APP-4. AutoCAD One-Line Diagram
APP-5. SKM Protective Device Summaries – Existing
APP-6. SKM Protective Device Summaries – With All Recommendations

3.4 FIELD SETTINGS AND IMPLEMENTATION OF APPROVED REPORT

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device evaluation study, and protective device coordination study.

B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short circuit and protective

device coordination study shall be carried out by the Contractor at no additional cost to the owner.

C. The Arc-Flash labels shall be applied to each piece of equipment.

END OF SECTION

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SECTION 16040

ELECTRICAL DEMOLITION AND ALTERATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 JOB CONDITIONS

A. The existing lift station shall remain in service during construction. Power outages and interruptions in building systems shall be held to a minimum and shall be done at a time convenient to the Owner. The time of all outages shall be scheduled with the Owner and all other trades affected by the outage at least ten working days in advance. All demolition work shall be scheduled at periods and times acceptable to the Owner.

B. Refer to demolition specification in Division 2, for areas and equipment being remodeled.

C. Prior to demolition or alteration of structures, the following shall be accomplished:
1. Owner release of such structure.
2. Disconnection of electrical power to equipment and circuits removed or affected by demolition work.
3. Electrical services rerouted or shut off outside area of demolition.
4. Coordinate sequencing with Owner and other Contractors.
5. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore existing facilities to their predemolition condition.

D. Notify utilities prior to razing operations to permit them to disconnect and remove and/or relocate any equipment that served existing facilities. It is the Contractor's responsibility to coordinate, with the Utility, any change to any existing service or installation of a new service. The Contractor shall keep the Engineer informed of all communications between him and the Utility.

E. Contractor shall dispose of all obsolete material.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 ELECTRIC SERVICE

A. De-energize and remove existing electric services per construction schedule and the electrical drawings.

3.2 MODIFICATIONS

A. Feeders, branch circuits, and other system wiring which are to remain in service but which are presently routed through areas being demolished shall be rerouted around demolition area.

B. Wall penetrations, which served conduits being removed, shall be patched.

C. Ceiling penetrations, which served conduits being removed, shall be patched.

3.3 REMOVAL

A. Electrical equipment in conflict with construction shall be removed or relocated as indicated on drawings, as directed, or required.

B. Remove or relocate: Conduit, wire, boxes, fixtures that are in the way of construction.

C. Reconnect circuits and equipment to be continued in service.

D. Provide temporary wiring to any equipment that is to remain in operation during demolition and whose power would be interrupted as a result of demolition.

E. Remove electrical equipment released from service as a result of construction or as indicated on drawings.

F. Do not reuse removed electrical equipment except as specifically directed on the drawings.

G. Where the plans require existing equipment to be removed or relocated, removal shall include all equipment associated with the device. Associated equipment shall include but not be limited to coverplates, backboxes, conduit, fittings, de-energized conductors, etc. In instances where a device is removed but active conductors remain in the backbox and the box is mounted in a wall which is remaining, the backbox may remain and a blank coverplate provided. If removal of the box is specifically indicated on the plans the active conductors shall be intercepted at convenient, accessible locations and rerouted to allow existing box to be removed. When boxes are removed from existing walls which will remain, it shall be the Contractor's responsibility to fill in openings and sand as required flush with adjacent surfaces. The Contractor shall be responsible for final finish work unless specifically indicated otherwise on the plans.

3.4 DISPOSAL

A. Dispose of equipment that is removed unless specifically indicated on the drawings.

B. Raceway, conductors, boxes, cabinets and supporting devices shall become the property of the Contractor and shall be removed from the site and disposed of by the Contractor.

C. The Contractor shall tour demolition areas with the Owner to determine the status of all other equipment to be removed during demolition. All equipment that is to be salvaged for reuse by the Owner shall be removed by the Contractor and transported to a owner designated storage area on the site. The Owner shall be responsible for removal of salvaged equipment from the storage area.

3.5 LIGHTING FIXTURE BALLAST DISPOSAL

A. Refer to Demolition Specification in Division 2.

3.6 LIGHTING FIXTURE LAMP DISPOSAL

A. Refer to Demolition Specification in Division 2.

3.7 ALTERATIONS

A. The Contractor shall be responsible for work of other trades to facilitate installation of electrical work in the existing building.

B. Work required by Electrical Contractor which is normally performed by other trades shall be done under direction and at the expense of Electrical Contractor.

END OF SECTION

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SECTION 16111

CONDUITS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide conduit systems for all power, control, and communications systems wiring as specified. Flexible, modular wiring systems shall not be used unless expressly accepted by the Engineer.

1.3 QUALITY ASSURANCE

A. National Electrical Contractor's Association (NECA) Standard of Installation.

B. National Electrical Code (NEC) Including State of Wisconsin and local supplements.

PART 2 PRODUCTS

2.1 GALVANIZED RIGID CONDUIT (GRC) AND INTERMEDIATE METAL CONDUIT (IMC)

A. Manufactured lengths, full weight, heavy wall, rigid steel conduit, protected inside and out by hot-dipped galvanized or electro-galvanized coating.

B. Minimum conduit size shall be 3/4 inch.

2.2 POLYVINYL CHLORIDE CONDUIT (PVC)

A. Standard lengths and sizes.

B. Minimum size 3/4" with the exception that the minimum size conduit for underground site lighting circuits shall be 1".

C. Schedule 40 or 80, heavy wall rigid plastic (PVC) conduit manufactured to NEMA TC-2 standards, UL listed, and as required by NEC. Sunlight resistant.

D. Rated for 90 degrees C. cable.

2.3 PVC COATED RIGID METAL CONDUIT

A. Per NEMA Standards Publication No. RN 1 - 1980 and ANSI C80.1. Shall be ETL Verified PVC-001 or shall meet UL Adhesion Test per ASTM B 117-94.

B. Rigid steel galvanized conduit with PVC coating.

C. Full weight 40 mil thick PVC coating, bonding to galvanized metal shall be stronger than plastic tensile strength.

D. Minimum conduit diameter shall be 3/4 inch.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Galvanized spiral strip flexible steel.

B. Standard conduit sizes.

C. Heavy wall sunlight resistant PVC jacket.

D. Minimum size 3/4 inch.

2.5 FLEXIBLE METAL CONDUIT

A. Galvanized spiral strip flexible steel.

B. Standard conduit sizes.

C. Minimum size 3/4" with the exception that 3/8" diameter may be used to serve individual lighting fixtures installed in a suspended accessible ceiling system.

PART 3 EXECUTION

3.1 GENERAL

A. Interior conduits for wiring systems rated up to 600 volts shall be galvanized rigid conduit (GRC). Exceptions to the requirements stated above are as follows:
   1. Conduits for feeder conductors shall be GRC regardless of conduit size.
   2. Conduits in poured concrete construction shall be GRC regardless of size.
   3. Flexible conduit where required by other paragraphs in this section.
   4. Conduits in hazardous locations.
   5. Conduits in corrosive areas.

B. Exterior underground conduit in direct contact with the earth and conduits embedded in concrete lighting fixture pole bases shall be heavy wall schedule 40 PVC except as follows:
   1. Underground conduit runs which enter or exit the building envelope shall utilize PVC-coated rigid metal conduit from the point of penetration of the building envelope and the next 5' portion of the run in direct contact with the earth.
   2. Underground conduit runs which contain adjustable frequency drive conductors shall be PVC-coated rigid metal.

C. Exterior exposed conduit (i.e. outside of building wall or above roof) shall be GRC.

D. Conduits encased in concrete as part of an underground electrical duct package shall be schedule 40 HW PVC except that conduits within 5' of a manhole or within 5' of the building envelope shall be PVC-coated rigid metal.

E. Conduits installed in corrosive areas shall be PVC coated rigid metal conduit. Corrosive areas are identified on the drawings.

F. Conduits containing only electrical service bare copper grounding conductors shall be HW PVC.

3.2 DIRECT BURIED UNDERGROUND CONDUIT

A. Exterior underground direct buried conduits shall be buried at a depth of not less than 30 inches below grade.

B. Provide conduits or ducts terminating below grade with means to prevent entry of dirt or moisture.

C. Underground conduits shall slope 1/8" per foot for proper drainage. Conduits shall drain toward manholes and junction boxes, not the electrical equipment.

3.3 PROCEDURES AND PRACTICES

A. Exposed raceway may be used. Where allowed, the general installation requirements are as follows.
   1. Raceways shall be routed horizontally along the corners of walls and ceilings, directly above edges of base molding at floors, or along the tops of window and door frames.
   2. Raceways shall be routed vertically along corners of adjacent walls and along the edges of window and door frames.
   3. Raceways shall not be routed down or across open wall surfaces except in portions of runs not exceeding 12" in length.
   4. Fittings and boxes used with raceways shall be specifically designed and approved for use with the raceways.
   5. Raceways may not be routed on or across finished floors.

B. All conduit in unfinished spaces shall be surface mounted (conduit routed in block or poured walls is not permitted). For general installation requirements, refer to item numbers 1 through 5 directly above.

C. Cut joints shall be square, reamed smooth, and drawn up tight.

D. Keep conduit plugged, clean, and dry during construction.

E. Install No. 12 pull wire in empty conduit.

F. Cap spare conduits.

G. Provide riser clamps around all conduits 1-1/4" or larger that are routed between floors.

H. Provide a watertight conduit system where installed in wet locations such as outdoors, underground, in wash-down areas, or where embedded in concrete.

I. For interior overhead conduit runs, the conduit shall be attached directly to the ceiling (conduit shall not be suspended from the ceiling at a lower elevation).

J. Conduits may be routed exposed in mechanical equipment, electrical, and utility rooms.

K. Route all conduits (including conduits routed above ceilings) parallel to or at right angles with lines of the building construction and structural members except conduit runs routed concealed in poured-in-place concrete floor slabs may be run in a direct line from source to load.

L. Make bends and offsets without kinking or destroying smooth bore of conduit. Arrange bends and offsets in parallel conduits to present a neat symmetrical appearance.

M. Secure conduits in place with malleable corrosion-proof alloy straps or hangers. Conduit straps used in corrosive areas shall be PVC coated.

N. The use of perforated strapping as a conduit hanging method is not approved.

O. Conduit runs that extend through areas of different temperature or atmospheric conditions shall be sealed using approved seal off devices, drained, and installed in a manner that will prevent drainage of moisture or gas migration into cabinets, and equipment enclosures.

P. Conduits routed within poured concrete construction (poured walls, floor slabs, topping slabs, etc.) shall comply with the following requirement.

1. Conduits shall be parallel to each other, spaced on center to center distance of at least three times conduit trade diameter, and provided with a minimum of 2 inches concrete covering. Contractor shall note that precast planks below topping slabs may camber. Topping slab thickness will be less at the high point of the camber.
2. Conduits larger than 1¼ inches ID shall not be installed in floor slabs. Conduits over 3/4 inches ID shall not be installed in topping slabs.
3. Conduits embedded in a structural frame slab shall comply with applicable provisions of American Concrete Institute (ACI), Standard 318. Refer to structural drawings for locations of structural frames.
4. Conduits used for feeders shall not be embedded in concrete floor slabs or concrete topping slabs.
5. Conduits in poured concrete construction shall not cross other conduits or other piping.
6. Unless specifically indicated on the electrical plans, conduits installed in (or under) the poured concrete construction shall be approved by the Engineer prior to conduit installation. The contractor will be required to submit drawings showing conduit sizes and routings to the Engineer for his review. Approval may not be given prior to bidding. Contractors who base their bid on the assumption that conduits will be allowed in concrete construction do so at their own risk. No changes will be made to the contract if, during construction, the Engineer prohibits the installation of conduit in concrete construction.

Q. In areas constructed of precast concrete conduits may be run in cores of planks.

R. Connections to Motors and Equipment Subject to Vibration:
1. Flexible steel conduit not over 3 ft. long for connection to motorized equipment.
2. Liquid-tight flexible conduit not over 3 ft. long where exposed to moisture, dirt, fumes, oil, corrosive atmosphere, with connectors to assure a liquid-tight, permanently grounded connection. Locate so it is least subject to physical abuse. Corrosive areas are identified on the floor plans.
3. Use double locknuts and insulated bushings with threads fully engaged.

S. Install bushings with ground lugs and integral plastic linings at equipment with open-bottom conduit entrances.

T. Install conduit expansion fittings where conduits cross expansion joints.

3.4 FIRESTOPPING

A. Provide firestopping at conduit penetrations through fire rated construction in accordance with section 16010.

3.5 CUTTING AND PATCHING

A. Provisions for openings, holes, and clearances through walls, floors, ceilings, and partitions shall be made in advance of construction.

B. Provide cutting, patching and painting necessary for the installation of electrical systems.

C. Where conduits need to penetrate concrete or masonry construction the contractor shall install 22 gauge galvanized steel pipe sleeves, 1 in. larger in diameter than the conduit being installed. Sleeves shall extend 2" above and below the floor slab or wall penetrated. Install sleeves before walls and/or slabs are poured or constructed.

D. The contractor shall prepare drawings indicating size and location of all anticipated floor sleeves for the installation of electrical conduits. Such drawings shall be made available 10 days prior to any scheduled concrete work.

3.6 RESTRICTIONS

A. Conduits routed parallel to steam lines, hot water pipes, flues, high temperature piping or ducts shall be routed at least 12" from such and shall be a minimum 12" clear when crossing same.

B. Do not route conduit over high temperature equipment.

C. Where conduits must cross or follow the same path as water, steam or other fluid piping, run electrical conduits above such piping wherever possible.

3.7 ADJUSTMENT AND CLEANING

A. Restore damaged areas on PVC jacketed, rigid conduit with spray type touch-up coating compound or as directed by manufacturer

B. Pull cleaning plug through conduits to clear of dirt, oil, and moisture.

3.8 CONDUIT SYSTEMS

A. Separate raceways shall be provided for each wiring category as follows;
   1. 120/240 volt normal power wiring systems.
   2. 480 volt normal power wiring systems.
   3. I&C: analog (twisted-shielded pair or triad)
   4. I&C: 120VAC control
   5. I&C: 24VAC control
   6. I&C: pulsed frequency (twisted-shielded pair)
   7. I&C: field instrument signal

Exceptions: Circuits consisting of twisted-shielded pair cable may share conduits with 120V power circuits. They may also share conduits containing 120V (or lower) control circuits. Circuits consisting of twisted-shielded triad cable may share conduits with 120V power circuits. They may also share conduits containing 120V (or lower) control circuits.

B. Fiber-optic cables shall be run in conduit. These raceways shall include sweeping elbows. Fiber-optic cables may be run with other I&C circuit types, but those conduits shall include sweeping elbows.

END OF SECTION

SECTION 16112

CONDUIT FITTINGS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide conduit fittings to form a complete raceway system as specified herein.

1.3 QUALITY ASSURANCE

A. Reference National Electrical Contractors Association (NECA) - Standard of Installation

PART 2 PRODUCTS

2.1 MATERIAL

A. Fittings shall be steel or malleable iron and shall be zinc galvanized, or cadmium plated.

B. Do not use running threads.

C. Do not use set screw or indentor type fittings.

2.2 CONNECTORS AND COUPLINGS

A. Galvanized Rigid Conduit and Intermediate Metal Conduit
   1. Threaded.
   2. Liquid tight.
   3. Insulated throat.

B. Polyvinyl Chloride (PVC)
   1. Schedule 40 or 80, to match conduit.

C. PVC Coated Galvanized Rigid Conduit
   1. Full weight 40 mil PVC jacket.
   2. PVC gasketed for mating surfaces.
   3. Same as for Rigid Conduit.

D. Liquidtight Flexible Metal Conduit
   1. Liquid tight.
   2. Suitable for grounding.
   3. Suitable for wet locations.

4. Tapered threaded hub.
5. Non-metallic materials.

E. Flexible Metal Conduit
1. Threaded.
2. Grounding type.
3. Insulated throat.
4. Two screw clamp type with locknuts.
5. Externally Secured.

2.3 EXPANSION FITTINGS

A. Expansion fittings: Copper bonding jumper, Crouse Hinds Type XJ.

B. Expansion/deflection fittings: Copper bonding jumper, Crouse-Hinds Type XD.

2.4 CONDUIT BODIES

A. Galvanized or cadmium plated.

B. Threaded hubs.

C. Removable cover, with gasket.

D. Corrosion-resistant screws.

2.5 SEALS

A. Wall entrance seals. Link Seal type as manufactured by Thunderline Corporation.

B. Explosion-proof seals. Appleton type EYS, SFM, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical fittings in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that fittings serve intended purposes.

B. Rigidly secure connectors at cabinets and boxes with galvanized lock nut and bushing. Use appropriate connectors on NEMA 3R (weatherproof) and NEMA 4 (spraytight) enclosures to maintain their ratings. NOTE: Conduit penetrations to NEMA 3R and NEMA 4 enclosures shall be made on the bottom (or the sides, if the bottom access is insufficient) – do not penetrate the top of the enclosure.

C. Seal conduits that run through different temperature or atmospheric conditions to prevent moisture or gases from entering electrical equipment and devices.

D. Install wall entrance seal where conduits or direct burial conductors pass through foundation walls below grade.

E. Install conduit expansion fittings complete with bonding jumper in following locations:
   1. Conduit runs which cross a structural expansion joint.
   2. Conduit runs where movement perpendicular to axis of conduit may be encountered.

F. Locate conduit bodies so as to assure accessibility of electrical wiring.

G. Install fittings designed for use with flexible liquid-tight conduit to ensure continuity of ground throughout the fittings and conduit and prevent entrance of moisture.

END OF SECTION

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SECTION 16120

LOW VOLTAGE WIRES, CABLES AND CONNECTORS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Application provisions of Division 0 and Division 1 shall govern work under this Section.

1.2 SCOPE

A. Provide wires, cables and connectors as specified herein.

1.3 QUALITY ASSURANCE

A. Reference Standards of the following associations.
   1. National Electrical Contractor's Association (NECA) - Standard of Installation
   2. Insulated Cable Engineers Association (ICEA)

PART 2 PRODUCTS

2.1 WIRE CONDUCTORS

A. Copper Conductor only.

B. Insulated with 600 volt insulation and color code conductors for low voltage (secondary feeders and branch circuits) as required by code.

C. Type THHN solid or stranded: Single conductor No. 10 AWG and smaller for general use wiring. No. 12 AWG minimum size.

D. Type THW or THHN Stranded: Single conductor No. 8 AWG and larger for general use wiring. Conductor triple rated for use as types THHN, THWN and MTW is approved.

E. Conductors installed in wet locations and areas with high humidity shall be type THW or XHHW. Wet locations shall include, but not be limited to, conduits installed in direct contact with the earth and underground electrical ductbanks.

F. Conductors shall not be installed at temperatures below the manufacturer’s minimum installation temperature.

2.2 COMMUNICATIONS CABLES

A. Communications cables shall be the type as called for in the specifications and drawings for the installation of various communications systems.

B. Cables routed exposed through return air ceiling plenums shall be smoke resistance teflon coated cable classified as type CLP or CMP communications cable.

2.3 JOINTS, TAPS AND SPLICES

A. Conductors No. 10 AWG and Smaller: 3M Scotch-lok compression type solderless connectors with plastic cover. Wire nuts are not acceptable.

B. Joints, Taps, and Splices in Conductors No. 8 AWG and Larger: Solderless compression type connectors, tool and die applied, of a type that will not loosen under vibration or normal strains. Burndy "Hy-Dent" type or equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

A. Run all wire and cable in conduit, unless otherwise indicated on drawings.

3.2 JOINTS, TAPS AND SPLICES

A. Each tap, joint, or splice in conductors No. 8 AWG and larger shall be taped with two half-lap layers of vinyl plastic electrical tape and a finish wrap of color coding tape, where required by code. Electrical tape shall be 3M Scotch brand.

B. Cable splices shall be made only in distribution and junction boxes.

3.3 WIRE AND CABLE IDENTIFICATION

A. Install label tags on wire and cable in junction boxes, pullboxes, wireways, and wiring gutters of panels. Tags identify wire or cable number and/or equipment served as shown on drawings.

B. Different conductor insulation colors and electrical tape colors shall be used to identify the different conductors in a given circuit. Code requirements shall always be followed where applicable. In general, colors shall be as follows;
   1. 120/208 volt systems neutral conductor - solid white. Provide additional markings for neutral conductors in the same raceway as required by code.
   2. 120/208-volt systems A-phase, B-phase, and C-phase unswitched legs. Solid black, solid red, and solid blue respectively. Different colors shall be used to identify switched legs.
   3. 480/277 volt systems neutral conductor - solid gray. Provide additional markings for neutral conductors in the same raceway as required by code.
   4. 480/277 volt systems A-phase, B-phase, and C-phase unswitched legs. Solid brown, solid orange, and solid yellow respectively. Different colors shall be used to identify switched legs.
   5. Ground Conductors - solid green. Provide additional markings for ground conductors in the same raceway as required by code.

3.4 LIGHTING FIXTURE OUTLETS

A. Use conductor with insulation suitable for current, voltage, and temperature to which conductor will be subjected

B. No. 12 wire size minimum for conductors supplying power to a single fixture. 600V insulation minimum.

C. Insulation suitable for operation at 90 degrees C. minimum for lighting fixtures with integral ballast, mogul base sockets, quartz lamps, or otherwise where subject to excessive temperatures.

D. Fixture wiring shall be continuous wiring system to lampholder or to ballast and from ballast to lampholder.

3.5 TAGS AND LABELS

A. Provide metal or flame-resistant adhesive label tags and identify the cable source, use and destination.

B. Line voltage conductors shall be identified by circuit number using sleeve type adhesive markers.

END OF SECTION

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SECTION 16121

FEEDER CIRCUITS

PART 1 GENERAL

1.1 DESCRIPTION

A. Applicable provisions of Division 1 and Division 0 shall govern work in this Section.

B. Requirements of this Section are applicable to feeders as defined in NEC Article 100.

1.2 QUALITY ASSURANCE

A. The installation shall conform to the requirements of the following:
   1. National Fire Protection Association (NFPA) - 70 - National Electrical Code (NEC) and Wisconsin amendments thereto.
   2. National Electrical Contractors Association (NECA) - Standard of Installation.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which feeders are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.

B. Extend feeders at full capacity from origin to termination. The extending or splicing of feeder circuits is not permitted.

C. Each conduit raceway shall contain only those conductors constituting a single feeder circuit.

D. Where feeder conductors are run in parallel, conductors shall be of same length, same material, circular-mil area, insulation type, and terminated in same manner.

E. Where parallel feeder conductors shall be run in separate raceways, each raceway shall have same physical characteristics.

F. Feeders shall follow most accessible routes, concealed in construction in finished areas, exposed to the minimum temperature gradient and to minimum temperature fluctuation.

G. Confine feeders to insulated portions of building, unless otherwise specified.

H. Trapped feeder runs without facilities for continuous drainage are not acceptable.

I. Do not draw conductors into conduits until building is enclosed and watertight and until work which may cause cable damage has been completed.

J. Feeder conduits shall not be routed in or under floor slabs or below basement or grade level floor slabs.

K. Each phase conductor of each feeder shall be identified at both ends and at all accessible locations with colored plastic tape. Each phase shall be identified by a different color as indicated in section 16120. Painted identification is not acceptable.

L. Feeder conductors in switchboards, panelboards, pullboxes, gutters, and other open wiring spaces shall be bundled by feeder using plastic tie wraps at intervals not greater than 3’ on center.

END OF SECTION

SECTION 16122

BRANCH CIRCUITS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide a branch wiring system to serve lighting, receptacle, instrument, motor and equipment loads as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Reference Standards of the National Electrical Contractors Association (NECA), Standard of Installation.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Conductors shall be size 12 AWG minimum (unless otherwise noted) for branch circuit wiring, including motor circuits.

B. Size 120V branch circuits for length of run on following basis:
   1. 0 to 75 ft run from panelboard to first outlet: No. 12 AWG minimum.
   2. 75 to 125 ft run: increase one wire size, i.e., No. 12 AWG becomes No. 10 AWG.
   3. 126 to 200 ft run: increase two wire sizes, i.e., No. 12 AWG becomes No. 8 AWG.
   4. 201 and above: wiring to be sized for 3% maximum voltage drop.

C. Provide individual neutral conductors for branch circuits serving isolated ground receptacles and computer equipment. (No common neutrals for these circuits.)

D. Voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of NEC Article 220.

E. Route branch circuits and switch legs as dictated by construction, these specifications, or instruction from Engineer.

F. Size conduit, outlet boxes, and other raceway system components in accordance with NEC requirements as minimum.

G. Do not draw conductor into conduits until building is enclosed and watertight and work which may cause cable damage has been completed.

H. Circuit numbers as shown on drawings are for Contractor to plan his wiring and for estimating purposes and are not necessarily the exact circuit numbers to be used in that panel for that particular load. Exact circuit numbers for each load are to be selected by the Contractor at his option. Balanced load on panelboard bus is to be determining factor in arrangement of circuits. Panelboards average load shall not differ from phase to phase by +/- 7½%.

3.2 MOTOR AND EQUIPMENT WIRING

A. Furnish and install motor circuits in accordance with any schedules on drawings and code requirements, from source of supply to associated motor starter, and from starter to motor terminal box, including necessary and required intermediate connections.

B. Conductor and conduit size for motor branch circuits, if shown on drawings, are sized for motor requirement only.

C. Motors shall have proper feeders as per NEC and nameplate ratings. Contractor is responsible for verification of ratings of motors and installing proper branch circuits.

D. Obtain manufacturer's wiring diagrams and shop drawings for equipment requiring electrical connections.

E. Check drawings and specifications of other divisions of work for equipment and work which shall be included in order to provide a complete electrical installation.

F. Motor connections shall be made by compression type connectors using proper tools and fittings to assure good electrical continuity and low resistance joint.

3.3 INSPECTION

A. Examine areas and conditions under which branch circuits are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.4 INSTALLATION

A. Install in accordance with manufacturer's written instructions and in accordance with recognized industry practices

B. Install branch circuit and control wiring system as indicated in drawings.

C. Use color-coding to identify conductors as indicated in Section 16120.

END OF SECTION

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SECTION 16130

ELECTRICAL BOXES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide electrical boxes in accordance with these specifications.

1.3 QUALITY ASSURANCE

A. Reference Standards of the National Electrical Contractors Association (NECA), Standard of Installation.

PART 2 PRODUCTS

2.1 INTERIOR WALL OUTLET AND SWITCH BOXES - SURFACE MOUNTED - DRY LOCATIONS ONLY

A. Stamped steel, four inch square, 2-1/8" deep, with round corners. Provide rounded corner raised box covers with openings as required for devices being installed. Refer to section 16111 for restrictions on exposed conduit systems.

2.2 INTERIOR WALL OUTLET AND SWITCH BOXES - SURFACE MOUNTED - DAMP OR WET LOCATION (includes areas with floor drains)

A. Single or two gang as indicated on the plans. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to section 16111 for restrictions on exposed conduit systems.

2.3 EXTERIOR WALL OUTLET AND SWITCH BOXES - SURFACE MOUNTED

A. Single or two gang as indicated on the plans. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to section 16111 for restrictions on exposed conduit systems.

2.4 CEILING BOXES - FLUSH MOUNTED - FOR SURFACE AND PENDANT LIGHT FIXTURES; DRY AREAS ONLY

A. Dropped ceiling construction. Stamped steel four inch octagon box set flush with finished surface, complete with 3/8 in. fixture stud.

B. Cast in place concrete construction. Stamped steel four-inch octagonal, galvanized concrete boxes, having a minimum depth of 3 in., complete with 3/8-in. fixture stud.

2.5 ELECTRICAL BOXES IN CORROSIVE LOCATIONS

A. PVC coated cast steel boxes compatible with conduit system installed. Coating shall cover both interior and exterior surfaces. See floor plans for identification of corrosive areas.

2.6 SPECIAL BOXES

A. Provide special boxes fabricated by the manufacturer of fixtures and other devices where standard outlets are not applicable.

2.7 GENERAL PURPOSE JUNCTION AND PULL BOXES (FOR DRY INTERIOR AREAS ONLY)

A. Fabricate from code gauge galvanized steel, with covers held in place by corrosion resistant machine screws

B. Size as required by code for number of conduits and conductors entering and leaving box.

C. Provide with welded seams, where applicable, and equip with corrosion-resistant nuts, bolts, screws, and washers.

2.8 ACCESS PANELS

A. Furnish type necessary for the particular wall or ceiling construction in which they occur.

B. Panels to be complete with screwdriver cam locking device.

2.9 WEATHERPROOF JUNCTION AND PULL BOXES (EXTERIOR AND DAMP/WET INTERIOR AREAS)

A. Stainless steel or cadmium plated malleable iron cast type with threaded hubs, cast cover, and neoprene gasket.

2.10 EXPLOSION-PROOF JUNCTION BOXES

A. Provide explosion-proof junction boxes for classified areas as indicated on the plans.

2.11 BETWEEN STUD BOX SUPPORT BRACKETS

A. Stamped and fabricated steel bracket designed to support 4" or 4-11/16" electrical boxes between wall studs.

B. Manufactured by Erico, RBS series or equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical boxes as indicated, in compliance with NEC requirements, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that the boxes serve the intended purposes.

B. Seal conduit at entrance to weatherproof boxes for interior and exterior locations exposed to weather or moisture.

C. Install knockout closures to cap unused knockout holes where blanks have been removed

D. Locate boxes so as to assure accessibility of electrical wiring. Relocate boxes rendered inaccessible by the installation of work by other trades.

E. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry. Do not support from conduit.

F. Set boxes, in concealed conduit runs, flush with wall surfaces, with or without covers, as required.

G. Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall a minimum 12 inches.

H. Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with the finished surface.

I. Do not burn conduit holes, use knock-out punches, or hole saws.

J. Use "no-bolt" studs where required.

K. Use handy boxes only where specifically detailed on the drawings.

L. Boxes shall be sized per code to accommodate the number and size of conduit entrances to the box and to accommodate the number of conductors, splices, fittings, etc. within the box. Do not use box extensions to create additional volume to meet NEC requirements for the number of conductors contained in a box.

3.2 EXPOSED OUTLET AND JUNCTION BOXES

A. Install weatherproof outlet and junction boxes outdoors and in any area where drawings show weatherproof (WP) wiring devices.

3.3 INTERIOR OUTLET BOX ACCESSORIES

A. Provide outlet box accessories as required for each installation, such as mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.

3.4 LIGHTING FIXTURE OUTLET BOXES

A. Securely mount with approved type bar hangers spanning structural members to support weight of fixture.

B. Do not support from conduit.

C. Equip with 3/8-inch fixture studs and tapped fixture ears, for surface mounted or pendant mounted lighting fixtures. Fixture studs shall be provided for mounting of all lighting fixtures exceeding 25 lbs. in weight. Fixture studs shall be attached through knockouts at the top of the box.

D. Provide additional attachments from structure for outlet boxes supporting lighting fixtures weighing in excess of 25 lb.

E. Provide cast outlet boxes for lighting fixtures in wet or damp areas.

3.5 OUTLET BOX LOCATIONS

A. Locate flush mounted wall boxes in corner of nearest brick or block to keep cutting to a minimum.

B. Location of outlets and equipment as shown on drawings is approximate, and exact location is to be verified and shall be determined by:

C. Construction or code requirements.

D. Conflict with equipment of other trades.

E. Equipment manufacturer's drawings.

F. Minor modification in the location of outlets and equipment is considered incidental up to a distance of 10 feet, provided the change in location is requested prior to rough in.

G. Mounting heights for devices and equipment to be measured from finished floor to centerline of device.

3.6 FLOAT SWITCH CABLE JUNCTION BOXES

A. Provide a NEMA 7 junction box for each group of float switches shown on the drawings. Provide each junction box whether the box is shown on the drawings or not. It is required to enable transition from waterproof float switch cable, to wire in conduit.

B. Install each junction box above the liquid level in an accessible location enabling future access.

C. Each penetration to each junction box shall be made in a manner that maintains the NEMA 7 integrity of the box. Refer also to section 16112 (Conduit Fittings).

3.7 SUBMERSIBLE PUMP/MIXER CABLE JUNCTION BOXES

A. Provide a NEMA 7 junction box for each submersible pump shown on the drawings. Provide each junction box whether the box is shown on the drawings or not. It is required to enable the separation of the moisture detection conductors and the high temperature conductors from the pump's power conductors. It is also required to enable transition from (waterproof) pump/mixer cable, to wire in conduit.

B. Install each junction box above the liquid level in an accessible location enabling future access.

C. Each penetration to each junction box shall be made in a manner that maintains the NEMA 7 integrity of the box. Refer also to section 16112 (Conduit Fittings).

END OF SECTION

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SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in the Section.

1.2 SCOPE

A. Provide wiring devices generally consisting of switches and receptacles as indicated on the drawings and as specified herein.

1.3 SHOP DRAWING SUBMITTALS

A. Listing of brand names and types of materials proposed for use.

B. Nameplate nomenclature.

C. Electrical ratings.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Use of manufacturer’s name and model or catalog number is for purpose of establishing standard of quality and general configuration desired only.

B. Arrow-Hart, Inc.

C. Hubbell Wiring Device Div.

D. Pass and Seymour, Inc.

E. Crouse-Hinds

F. Leviton

G. General Electric

2.2 GENERAL

A. Provide factory-fabricated, NEMA specification grade wiring devices in type, color, and electrical rating for service indicated.

B. Provide wiring devices of one manufacturer.

C. See Symbols List on drawings for identification of device type.

D. Wiring devices for use with stranded conductor shall have a clamping type terminal that can be physically tightened. The clamping device shall not be a spring type of clamp.

2.3 SWITCHES

A. Single Pole Switch:
1. Hubbell Model 1221-I.
2. Arrow-Hart. Model 1991-I.
3. Or equal.

B. Indicator Switch:
1. Hubbell. Model 1221-Il.
2. Arrow-Hart. Model 1921-IL.
3. Or equal.

C. Weather Proof Switch:
1. Hubbell. Model 1221/Crouse-Hinds DC 1SBG Cover
2. Or equal.

D. Explosion Proof Switches:
1. Appleton. Model EFS Series.
2. Crouse-Hinds. Model EFS Series.

2.4 RECEPTACLES

A. Duplex Convenience Receptacle:
1. Hubbell. Model 5262-I.
2. Arrow-Hart. Model 5262.
3. Or equal.

B. GFCI Receptacle:
1. Hubbell Model GF – 5362 – Indoor with WPFS26 Outdoor.
2. Or equal.

C. Explosion-proof Receptacle:
1. Appleton Model EFS B175-2023M.
2. Crouse-Hinds Model ENR 21201.
3. Or equal.

2.5 WIRING DEVICE PLATES AND COVERS

A. Provide wall plates for wiring devices, with ganging and cutouts as indicated and with metal screws for securing plates to devices, screw heads colored to match finish of plate.

B. Plates for flush mounted devices in dry areas: Coverplates shall be of plastic, non-combustible, mar-proof thermosetting material, minimum 0.100” thick. Color of plates

shall be of ivory except that color shall be red for devices associated with emergency circuits.

C. Device plates for surface mounted Type FS or FD boxes: Type FSK galvanized steel cover.

D. Device plates for surface mounted 4-inch square boxes: ½ in. raised galvanized steel covers.

E. Plates and covers for exterior outlet boxes and exterior switch boxes in damp or wet locations: Stainless steel with gasketed, lift, spring close, locking coverplate. Pass and Seymour model number WP26-L.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which wiring devices are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. Do not install devices until wiring is complete.

C. Do not install devices until after wall finishes (wall covering, painting, wallpaper, etc) have been completely applied. Any outlets installed prior to walls being finished and used for construction power shall be replaced at the time of substantial completion.

D. Before installing receptacles and switches, clean electrical boxes of dirt and debris.

E. Do not use terminals on wiring devices (hot or neutral) for feed-through connections, looped or otherwise. Make circuit connections via wire connectors and pigtails.

F. Install gasket plates for devices or system components having light emitting features, such as switches with pilot lights. Where installed on rough textured surfaces, seal plates with black self-adhesive poly-foam.

G. Ground receptacles with an insulated green ground wire from device ground screw to a bolted outlet box connection. Route a continuous green equipment grounding conductor with branch circuit conductors serving isolated ground receptacles. Terminate the equipment ground on the ground bus in panelboards.

H. Install emergency switches which occur adjacent to normal light switches in separate boxes to maintain systems isolation in accordance with the NEC. Provide red wiring devices and coverplates for devices wired to emergency power circuits.

I. Stranded conductor terminating on wiring devices shall be terminated in a clamping terminal and not on the screw terminal.

J. Provide a layer of electrical tape around the perimeter sides of each wiring device so that the terminations are insulated.

K. Where GFI protected receptacles are indicated on the plans, each receptacle indicated shall be a GFI receptacle. Standard receptacles protected with an upstream GFI receptacle shall not be approved.

3.3 FIELD QUALITY CONTROL

A. Provide operational testing for all devices.

B. Test receptacles with Hubbell 5200, Woodhead 1750, or equal, for correct polarity. proper ground connection, and wiring faults.

END OF SECTION

SECTION 16170

MOTOR AND CIRCUIT DISCONNECTS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide disconnect switches for the safe disconnection of motorized equipment and other equipment as required by the national and state electrical codes, O.S.H.A., and as specified herein.

1.3 SHOP DRAWING SUBMITTALS

A. Enclosure dimensions, nameplate nomenclature, electrical ratings, and breaker type listing.

B. Field quality control test results.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not store exposed to weather.

B. Protect against damage from work of other trades.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric

B. Siemens

C. Square D

D. Cutler-Hammer\Westinghouse\Eaton

2.2 DISCONNECT RATINGS

A. UL listed short circuit rating. 200,000 RMS amps with Class R fuses.

2.3 SAFETY SWITCH CONSTRUCTION

A. Twenty amp, one pole, non-fusible.
   1. Toggle type operator.
   2. Toggle guard capable of locking switch in the on or off position.
   3. Rated 1HP at 120 volts AC.

B. Switches other than twenty amp, one pole.
   1. NEMA heavy duty Type HD.
   2. Dual cover interlock.
   3. Visible blades.
   4. Provisions for control circuit interlock (aux. contacts). Once Form C set of aux. contacts is required for each disconnect associated with a VFD-driven load.
   5. Pin type hinges.
   6. Tin plated copper current carrying parts.
   7. Quick make and break operator mechanism.
   8. Handle attached to box, not cover.
   9. Handle position indication, ON in up position and OFF in down position.
   10. Padlock provisions for up to three padlocks in OFF position.
   11. UL listed lugs for type and size of wire specified.
   12. Spring reinforced fuse clips for Type R fuses where fusible disconnect is indicated or required.
   13. Provisions for insulated or grounded neutral.

2.4 ENCLOSED CIRCUIT BREAKER CONSTRUCTION

A. Dual cover interlock.

B. External trip indication.

C. Provisions for control circuit interlock.

D. Padlock provisions for up to three padlocks in OFF position.

E. Handle attached to box, not cover.

F. Handle position indicates ON, OFF, or TRIPPED.

G. Provisions for insulated or grounded neutral.

2.5 ENCLOSURES

A. Indoor dry areas. NEMA 1 code gauge steel with rust inhibiting primer and baked enamel finish.

B. Indoor damp or below grade. NEMA 3R.

C. Indoor wet. NEMA 4.

D. Outdoor. NEMA 4.

E. Corrosive Area. NEMA 4X Type 304 stainless steel with brushed finish.

F. Hazardous Area. NEMA 7/9 cast, copper free, aluminum alloy.

2.6 NAMEPLATES

A. Engraved laminated plastic type.

B. Letters 1/2 in. high.

C. Black letters on white background.

D. Identify per equipment controlled.

PART 3 EXECUTION

3.1 GENERAL

A. Provide a disconnect switch for each motorized load and for each electrical heating load, whether indicated on the drawings or not. Each local disconnect switch shall be located within line-of-sight of the associated load, and shall be suitably rated. The Contractor shall provide a pedestal in each case where there is no suitable vertical surface for mounting a disconnect switch. Some equipment is furnished with an integral or loose disconnect switch, so the Contractor shall review all specifications to determine what equipment is furnished with a disconnect switch. The Contractor shall include in their bid all disconnect switches required whether indicated on the drawings or not.

3.2 INSPECTION

A. Examine area to receive disconnect to assure adequate clearance for installation.

B. Start work only after unsatisfactory conditions are corrected.

3.3 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. Locate disconnect switches as shown on drawings or as required by NEC.

C. Install on equipment support where feasible, or anchor firmly to wall or structural surface.

D. Provide control circuit interlock as required by NEC.

E. For each disconnect switch associated with an ASC, provide two #12 wires in a ¾" conduit back to the ASC.

3.4 ADJUSTMENT

A. Adjust covers and operating mechanism for free mechanical movement.

B. Verify overcurrent protection to provide proper operation and compliance with NEC.

C. Tighten wire and cable connections.

D. Clean interior of enclosure.

E. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section

1.2 SCOPE

A. Provide equipment for the support of electrical equipment as detailed or indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Reference standards of the following agencies;
   1. National Electrical Contractors Association (NECA), Standard of Installation.
   2. National Electrical Manufacturers Association (NEMA).
   3. American National Standards Institute (ANSI).

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kindorf, Midland-Ross Corp.

B. Elcen Co.

C. Steel City, Midland-Ross Corp.

D. Unistrut

E. B-Line

2.2 GENERAL

A. For dry and damp interior spaces: metal supporting devices shall be zinc galvanized or cadmium plated steel or malleable iron.

B. For corrosive areas: all metal supporting devices shall be suitable for use in corrosive areas – they shall include a protective coating guaranteed by the manufacturer not to show any sign of corrosion for a minimum of ten years.

C. Provide anchor bolts, concrete anchors, and masonry anchors as specified in Section 05500.

2.3 LIGHTING FIXTURE SUPPORT

A. Items such as stems, hickeys, bar hangers, and clips are required to securely attach fixtures to ceilings or walls.

B. Provide studs and unistrut support for fixture outlet and ceiling support.

C. Provide fixture grid hangers for mounting surface fluorescent units to exposed grid ceiling.

D. Drilled expansion insert type anchors are suitable for load and application requirements such as sleeve anchors, lag shields, and plastic anchors.

E. Provide auxiliary supports so that fixtures can be drawn up tightly, cannot be tilted or rotated, and will not be affected by vibrations.

2.4 SUPPORT STRUCTURES

A. Rack supports of galvanized steel channel sections with adequate feet to allow secure mounting.

B. Weld sections, do not use bolts.

2.5 MOUNTING PANELS

A. Size mounting panels to mount necessary equipment, of ¾ in. exterior grade plywood or as specified on drawings.

B. Provide mounting panels for all surface mounted electrical cabinets and enclosures for electrical equipment.

C. Provide uniform mounting panels as far as practical. Preferred sizes being 12 in. X 18 in., 18 in. X 24 in., 18 in. X 30 in., and 24 in. X 30 in.

2.6 CONDUIT SUPPORTS

A. Two hole galvanized steel straps.

B. Continuous slot or T-slot galvanized steel concrete insert channel.

2.7 TRANSFORMER MOUNTING BRACKETS

A. Provide mounting brackets fabricated of welded galvanized steel channel section.

B. Design bracket to support the size transformer as indicated on drawings.

PART 3 EXECUTION

3.1 PREPARATION

A. Install hangers, supports, and anchors only after structural work, where work is to be installed, has been completed. Correct inadequacies such as proper placement of inserts, anchors, and other building structural attachments.

B. Examine areas and conditions under which equipment and associated components are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Determine that ceiling channel system is adequately supported to receive and support lighting fixtures. Where deemed inadequate, do not install fixtures until additional support is provided.

3.2 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on to structural steel or raceway and equipment support.

B. Install additional building attachments where support is required for additional concentrated loads.

C. Install concrete inserts before concrete is placed.

3.3 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent the transfer of loading and stresses to connected equipment.

B. Installation methods shall be in conformity with the manufacturer's recommendations for maximum holding power, but in no case shall the depth of hole be less than four bolt diameters. Minimum distance between the center of any expansion anchor and an edge of exterior corner of concrete shall be not less than 4½ times the diameter of the hole in which it is installed.

3.4 SUPPORT OF CONDUIT

A. Fasten conduit to structural parts of building in a manner acceptable to Engineer.

B. Do not use perforated hanger iron.

C. Install concrete insert channel as required, with spacings as recommended by manufacturer. Install with anchor and caps, insert joiner clips and closer seals as required.

D. Support conduit as follows;
   1. Single Conduit Runs

a. Vertical Surfaces: Galvanized, heavy duty, sheet steel straps; back straps to be provided for all exposed conduit and conduit on exterior walls.
b. Horizontal Surfaces: Galvanized, heavy duty, 2-hole steel pipe straps.

2. Multiple Conduit Runs
   a. Vertical Surfaces: Horizontal or vertical rack channel with conduit straps as required.
   b. Horizontal Surfaces: Single or double rack channel trapeze, complete with conduit straps as required; all supported with threaded hanger rods.
3. Passing Between Floors and Through Roof 1¼ in. and larger conduit runs passing through floors shall be supported at each floor with riser pipe clamps.
4. Conduit extending through roof shall pass through a ceiling box at roof lines.
5. Provide 14 ga minimum copper box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit.
6. Conduit and pitch pocket shall be installed in advance of roofing work.

3.5 TRANSFORMER SUPPORTS

A. Install auxiliary transformer wall mounting brackets where all mounted transformers are indicated on drawings.

END OF SECTION

SECTION 16402

UNDERGROUND ELECTRIC SERVICE MODIFICATIONS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide modified facilities for an underground electrical service as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Reference the local electrical utility's Service Rules and Regulations.

1.4 SUBMITTALS

A. Submit shop drawings of service entrance equipment for approval by the Electrical Utility before submitting approved drawings to Engineer.

PART 2 PRODUCTS

2.1 ELECTRIC SERVICE

A. Electric service characteristics for this project shall be as indicated on drawings.

PART 3 EXECUTION

3.1 PREPARATION

A. Confirmation of electric service. Consult with Electric Utility to verify service information specified herein and shown on drawings before submitting bid.

B. Metering.
1. Consult with Electric Utility regarding service entrance requirements and metering equipment.
2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility.

C. Electric Utility Charges shall be paid from the Utility Allowance.

3.2 SERVICE INSTALLATION

A. Provide a ductbank extension from the building for incoming service lateral conductors as shown on drawings.

B. The service installation shall comply with the latest applicable standards of the utility. Refer to the current electrical service installation manuals.

C. The Contractor shall meet with the electric utility prior to rough-in to review and coordinate the installation of the electrical service and verify existing conditions and any special requirements.

D. If requested by the Utility or Engineer, the Contractor shall meet with the Utility at the project site at the time of new service installation.

END OF SECTION

SECTION 16421

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall apply to all work of this Section.

1.2 DESCRIPTION

A. Furnish and install Category C surge protective devices (SPDs) as shown on the drawings and herein specified. Unit shall have a 160KA surge handling capacity, minimum.

1.3 QUALITY ASSURANCE

A. Each SPD shall be listed under UL 1449 Third Edition, labeled and tested to ANSI/IEEE Standards C62.41-1996.

B. Each unit shall be designed and manufactured by a qualified manufacturer of power conditioning equipment. The qualified manufacturer must have been engaged in the design and manufacturer of such products for a minimum of five years.

1.4 SUBMITTALS

A. Product data required.

B. Submittal shall include confirmation of ALL ratings specified.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. MCG

B. Engineer – approved equal.

2.2 ENVIRONMENTAL REQUIREMENTS

A. Storage temperature range shall be -40°C to 85°C.

B. Operating temperature range shall be -40°C to 70°C.

2.3 DOCUMENTATION

A. Manufacturer shall furnish an installation manual with installation, start up and operating instructions for the specified system.

B. Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details and wiring diagram.

C. Documentation of specified system's UL 1449 listing and clamping voltage ratings shall be included as required product data submittal information.

2.4 WARRANTY

A. Manufacturer shall provide a full ten year warranty against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements and any applicable national or local electrical codes. Replaceable modules shall have a lifetime warranty from the Manufacturer.

2.5 EQUIPMENT

A. Unit shall include special low impedance interface cable.

B. LED indicators shall be provided on the front cover to redundantly indicate unit module status. The system shall reliably indicate that one or more surge current diversion modules has failed and that service is needed to restore full operation. Additionally, a Form C (one N.O. and one N.C.) summary alarm contact rated for at least 120 VAC and 1 ampere shall be provided for remote annunciation of unit status. The summary alarm contact shall change state if any one or more of the surge current diversion modules has failed.

C. Specified system shall be equipped with an audible alarm which shall be activated when any one or more of the surge current diversion modules has failed.

D. A TVSS counter shall be included to totalize transient voltage surges.

E. Unit shall include noise filtering.

F. Unit shall protect L-G, L-N, L-L, and N-G.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all surge suppressors where shown on drawings in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide all material, labor and incidentals necessary for the completion of this section of the work.

1.3 QUALITY ASSURANCE

A. Follow the requirements of the following regulatory agencies;
   1. National Fire Protection Association (NFPA), NFPA-70 - National Electrical Code (NEC) and Wisconsin amendments thereto.
   2. Local Codes and Ordinances

1.4 REFERENCE STANDARDS

A. Conform to the standards of the National Electrical Contractors Association (NECA), Standard of Installation.

1.5 SUBMITTALS

A. Ground rod locations.

B. Ground resistance at each ground rod.

C. Soil conditions.

D. Building water service resistance

PART 2 PRODUCTS

2.1 GROUND CLAMPS

A. Ground clamp fittings shall be interlocking clamp type fabricated from high strength corrosion-resistant metal with high strength silicon bronze U-bolt, nuts, and lock washers.

2.2 GROUND RODS

A. Thick copper covering inseparably welded to a strong steel core.

B. ¾ in. diameter minimum

C. Ten feet long minimum

D. Furnish and install up to three rods, positioned in a triangular pattern (spaced 15 feet apart) to achieve 5 ohms or less.

2.3 GROUND WIRES

A. Copper only

B. Size as shown on drawings, or as required by NEC

C. No. 6 AWG minimum

PART 3 EXECUTION

3.1 GENERAL

A. Ground electrical systems and equipment as required by code, utility, local ordinances, and to requirements herein.

B. Install separate code rated grounding conductors to special equipment and activity areas as required by code.

C. Bond all metallic piping systems and service equipment as required by NEC.

D. Cable connections and joints shall be thermo-welded.

3.2 SYSTEM GROUND

A. Grounding electrode conductor shall be permitted to be attached to other grounding electrodes where available in the building as defined in NEC Article 250-81 in lieu of attaching to water service.

B. Building steel shall be used where available.

C. Drive ground rods to a depth 4 inches below finished grade.

D. Grounding electrode conductor.
   1. Continuous without splice from nearest building grounding electrode. Ground to service equipment.
   2. Install bonding jumper around water meter.
   3. Install in rigid metal conduit securely fastened to pipe.
   4. Attach non-ferrous metal tag to warn against removal.
   5. Make connections to ground electrodes with approved molded exothermic weld process.

3.3 EQUIPMENT GROUND

A. Bond metallic conduits, supports, cabinets, and other equipment so ground will be electrically continuous from service to outlet boxes.

B. Install grounding conductor in nonmetallic and flexible conduit to complete equipment ground continuity. Ground wire shall be bonded at equipment and at first junction box of conduit system on line side of flexible conduit to the system.

C. Install grounding conductors to permit shortest and most direct path from equipment to ground. When grounding conductor runs through metallic conduit, bond to conduit at entrance and exit with a bolted clamp.

D. Ground neutral at service-entrance only.

E. Install a separate equipment grounding conductor in each conduit containing feeder conductors.

F. Install a green equipment grounding conductor in all conduits serving receptacles and special purpose outlets.

G. Provide dedicated equipment grounding conductors with all circuits serving isolated ground receptacles. Isolated ground conductors shall have a green jacket with a yellow stripe.

H. Green ground bar in panels: shall be similar to neutral bar, except tinted green and bonded to panel tub.

I. Connections shall be accessible for inspection and checking. No insulation shall be installed over ground connections.

J. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

K. Attach grounds permanently before permanent building service is energized.

L. Ground metal lighting poles. Install a ground lug on wall of pole directly across from handhole.

M. Attach ground wire neatly and firmly to walls.

3.4 FIELD QUALITY CONTROL

A. Contractor shall make ground resistance measurements. Measure in normally dry conditions, not less than 48 hours after rainfall.

B. Report ground resistance measurement to Engineer within 48 hours of measurement.

END OF SECTION

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SECTION 16461

LOW VOLTAGE DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work of this Section

1.2 SCOPE

A. Provide auxiliary transformers of the KVA rating and voltage characteristics as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Equipment shall conform to the requirements of the following agencies:
   1. National Fire Protection Association (NFPA). National Electrical Code (NEC) and Chapter 70 and Wisconsin amendments thereto.
   2. Underwriters' Laboratories, Inc. (UL)
   3. Local Codes and Ordinances.
   4. National Electrical Manufacturers Association (NEMA)
   5. American National Standards Institute (ANSI)
   6. National Electrical Contractors Association (NECA)
   7. Department of Energy (DOE) 2016

B. Transformers shall be subject to the following production tests:
   1. Applied potential.
   2. Induced potential.
   3. No load losses.
   4. Voltage ratio.
   5. Polarity.
   6. Continuity.

1.4. SUBMITTALS

C. Shop drawings shall be in accordance with Section 16010. Shop drawings shall include:
   1. Manufacturer's nameplate data and electrical ratings.
   2. Dimensioned drawings of transformers and accessories.
   3. Submit operating and maintenance data.
   4. Submit field quality control test and adjustment data

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric

B. Square D

C. Siemens

D. Cutler-Hammer/Westinghouse/Eaton

2.2 MATERIALS AND EQUIPMENT

A. Transformers shall be dry type, air cooled.

B. Insulation shall be Class H or better, having a minimum 115°C. rise, average maximum over 40°C. temperature ambient.

C. Cores shall be high grade, non-aging, sheet silicon steel laminations having core plating insulation on both sides of each lamination.

D. Coils shall be continuous wound, impregnated with non-hygroscopic varnish, and the coil/core shall be bolted to bottom of enclosure. Coil conductors shall be continuous with termination pad brazed or welded.

E. No metal-to-metal contact shall occur between coil/core and enclosure. Coil/core and enclosure shall be isolated by rubber, vibration absorbing mounts.

F. Transformer shall contain four taps. Two 2½% taps above and two 2½% taps below.

G. Overload Capacity shall be not less than 15% for continuous operation.

H. Sizes as indicated on drawings and schedules.

I. Transformers shall be quiet type for installation in areas of low ambient noise levels. Maximum sound levels shall not exceed NEMA standards.

J. Cabinets shall be sheet steel, phosphatized having one prime coat and two finish coats of baked enamel.

K. Wall mounting brackets through 75 KVA.

L. Nameplate shall be a metal nameplate listing manufacturer's name, serial number, type, class, KVA voltage, frequency, and showing internal wiring diagram.

M. The following requirements shall be in accordance with Underwriters' Laboratories specification UL506:
   1. Ventilation openings.
   2. Corrosion resistance.
   3. Cable bending space.
   4. Grounding provisions.
   5. Surface temperature.
   6. Winding compartment temperature rise.
   7. Terminations.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which transformers are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TRANSFORMERS

A. Install in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.

B. Install wall mounted transformers on prefabricated brackets designed for purpose.

C. Install floor mounted transformers on 4 in. concrete housekeeping pad.

D. Tighten bus connections and mechanical fasteners.

E. Install fuses or breakers as shown on drawings.

F. Adjust voltage taps for required system voltage and check grounding requirements.

G. Touch up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

A. Test and permanently record as follows:
   1. Prior to energization of transformers, check phase-to-phase and phase-to-ground insulation resistance levels.
   2. Check transformers for continuity of circuits and for short circuits.
   3. Subsequent to wire and cable hook-ups, energize transformers and demonstrate function.

3.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle carefully to prevent internal component damage, breakage, and denting and scoring the enclosure finish. Do not install damaged transformers.

B. Store transformers in a clean dry space. Protect from dirt, fumes, water, construction debris, and physical damage

END OF SECTION

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SECTION 16470

ELECTRICAL PANELBOARDS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide panelboards as indicated in the panel schedule, as noted on the drawings and as specified herein.

1.3 SUBMITTALS

A. Shop Drawings
   1. Cabinet dimensions, nameplate nomenclature, electrical ratings, and breaker type listing.
   2. Product data sheets with installation instructions.
   3. Field quality control test results.
   4. Operating and maintenance data.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Do not store panelboards exposed to weather.

B. Protect panelboards against damage from work of other trades.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Use of a manufacturer's name and model or catalog number is for the purpose of establishing standard of quality and general configuration desired.

B. Square D

C. Siemens

D. General Electric

E. Cutler-Hammer/Westinghouse/Eaton

2.2 PANELBOARD RATINGS

A. UL listed short circuit rating (integral equipment rating):
   1. 120/240V Lighting Panels: 10,000 RMS symmetrical amperes minimum equivalent to Square D type NQOD.
   2. 480Y/277V Power Panels: 22,000 RMS symmetrical amperes minimum or as specified on the drawings.

2.3 PANELBOARD AND POWER PANEL CONSTRUCTION

A. Main breaker per panelboard schedule and drawings. The main breaker shall include a sensor plug and Micrologic (or equal) trip unit that includes LSI, residual ground fault, and ground fault trip.

B. Branch circuit breaker handles shall include ability for pad-locking in the OFF position.

2.4 BUSSING

A. Plated copper phase bussing.

B. Plated copper neutral bus with terminals.

C. Copper equipment grounding bus with terminals.

D. Distributed phase sequence type.

E. Ratings per panelboard schedule, 100 amp minimum.

2.5 PANELBOARD CABINETS

A. Code gauge galvanized steel.

B. Minimum 20" wide.

C. Minimum 5¾" deep.

D. Height as required to accommodate breakers and spaces indicated on plans and code required gutter space

E. Gutters adequate for wire size used, 4 inches minimum.

2.6 PANEL FRONTS

A. Dead front safety type.

B. Concealed adjustable trim clamps.

C. Code gauge steel with rust inhibiting primer and baked enamel finish.

D. Panel front cover shall have piano hinge to allow access to wiring gutters with out removal of panel trim. Hinged trim held in place with screw fasteners. Door shall be built into trim which allows access to breakers as well as to hinged trim screw fasteners. Breaker access door shall have the following features.
   1. Concealed piano hinge.
   2. Flush stainless steel cylinder tumbler type locks with spring loaded door pulls.
   3. Locks for all job panels keyed alike.
   4. Steel frame circuit directory holder with directory cards on inside face.
   5. Suitable for complete descriptions.
   6. Clear plastic cover.

2.7 BRANCH BREAKER DETAILS

A. Conform to Section 16475.

B. UL Class A ground fault circuit protection (GFI) as indicated on drawings.

C. UL listed terminals for type and temperature rating of wire utilized. Anti-turn solderless type.

D. Circuit breaker construction for NQOD panels shall bolt on to panel bussing.

E. Circuit breaker construction for power panels shall plug on to panel bussing but breaker cases shall bolt to panel cabinet.

2.8 NAMEPLATES

A. Engraved laminated plastic type.

B. Letters 1/2 inch high.

C. Black letters on white background.

D. Verify final panelboard designation with the owner's representative.

2.9 ARC FLASH WARNING LABELS

A. All panelboards shall include a warning label indicating the risk of arc flash. The warning label shall comply with N.E.C. article 110.16 and O.S.H.A. 29.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine area to receive panelboard to assure adequate clearance for panelboard installation.

B. Start work only after unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. Flush mount, surface mount, and install as specified on drawings and schedules.

C. Support panel cabinets independently to structure with no weight bearing on conduits.

D. Install recessed panelboards to allow cover to be drawn tight against wall to provide neat appearance.

E. Install panelboards so top breaker is not higher than 6 ft-0 in. above floor.

F. Adjacent panel cabinets shall be of same size and mounted in horizontal alignment.

G. Install in each panelboard a typewritten directory accurately indicating rooms and/or equipment being served.

H. Attach nameplates. Nameplates for panels in public areas shall be attached to the inside face of the cover. Nameplates for panels in equipment rooms and other non-public areas shall be attached to the outside face of the cover.

3.3 FIELD QUALITY CONTROL

A. Balance load among feeder conductors.

B. Unbalance shall not exceed ± 7½% of computed average load per phase.

C. Energize each circuit and check for complete and correct function.

3.4 ADJUSTMENT AND CLEANING

A. Adjust doors and operating mechanisms for free mechanical movement.

B. Tighten lugs and bus connections.

C. Clean interior of panelboard.

D. Sand, prime and paint scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 16475

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide overcurrent devices of the sizes and interrupting ratings as indicated on the drawings and as specified herein.

1.3 SUBMITTALS

A. Shop Drawings
   1. Device dimensions, nameplate nomenclature and electrical ratings.
   2. Product data sheets with installation instructions.
   3. Time current characteristic curves for each size and type of device.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Molded case circuit breakers.
   1. Square D
   2. Westinghouse/Cutler-Hammer/Eaton Co.
   3. Siemens
   4. General Electric

2.2 LIGHTING PANEL CIRCUIT BREAKERS

A. Thermal and magnetic protection.

B. Single-handle common trip, two and three poles (handle ties not acceptable).

C. Bolt-on type.

D. Quick make and break toggle action.

E. Handle trip indication.

F. Handle position indication, ON in up position, OFF in down position, and TRIPPED centered.

G. UL listed for type and temperature rating of wire specified.

H. UL listed short circuit rating (integrated equipment rating):
   1. Up to 240V: 10,000 RMS symmetrical amperes minimum.
   2. Up to 480V: 14,000 RMS symmetrical amperes minimum.

I. UL SWDL switching duty on 120V circuits where loads are panel switched.

2.3 POWER PANEL BRANCH CIRCUIT BREAKERS

A. Thermal and magnetic protection.

B. Single magnetic trip adjustment.

C. Single-handle common trip, two and three poles (handle ties not acceptable)

D. Push-to-trip test button.

E. Breakers shall plug on to panel bussing but breaker cases shall be bolted to panel housing.

F. Quick make and break toggle action.

G. Handle trip indication.

H. Handle position indication, ON in up position, OFF in down position, and TRIPPED center.

I. UL listed for type and temperature rating of wire specified.

2.4 CURRENT LIMITING CIRCUIT BREAKERS

A. One current limiter per pole.

B. Blown current limiter to trip all poles.

C. UL Listed Short Circuit Rating: 100,000 RMS symmetrical amperes.

D. Other features as specified above.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine fusible equipment for size and type of fuse to ensure selective coordination.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. All overcurrent protection devices by same manufacturer.

C. Circuit breakers shall be factory installed in enclosures.

3.3 ADJUSTMENT

A. Adjustable settings on circuit breakers shall be set to provide selective coordination, proper operation and compliance with NEC.

3.4 FIELD QUALITY CONTROL

A. Test and/or permanently record the following:

B. Circuit Breakers
1. Nameplate data
2. Actual trip setting

END OF SECTION

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SECTION 16479

FIBER OPTIC CABLES AND CONNECTORS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Application provisions of Division 0 and Division 1 shall govern work under this Section.

1.2 SCOPE

A. Provide fiber optic cables and connectors as specified herein.

1.3 RELATED WORK

A. Section 16111 - Conduits

1.4 QUALITY ASSURANCE

A. Reference Standards of the following associations.
   1. National Electrical Contractor's Association (NECA) - Standard of Installation
   2. Insulated Cable Engineers Association (ICEA)
   3. National Electric Code (NEC) Section 770.
   4. Non-Plenum Applications- UL-1581 and UL-1666 Flame Tests.
   5. Plenum Applications- UL-910 (NFPA 262-1994) Flame Tests.

PART 2 PRODUCTS

2.1 FIBER CABLE CHARACTERISTICS

A. All fibers in the cable must be usable fibers and meet requirement specifications.

B. MULTIMODE 62.5/125 um: Meet EIA/TIA-492AAAA-1989.

C. Each cable shall have a minimum of 12 fibers with male ST connectors at each end of each fiber.

D. The maximum attenuation shall be 3.5dB/km. Bandwidth of each fiber shall be >200Mhz at 850nm and > 500Mhz at 1300nm. The fiber shall be guaranteed to be compatible with laser-based gigabit Ethernet transmission systems for lengths up to 300 m.

E. Operating temperature range shall be -20 to +70 Degrees C. Storage temperature of down to -40 Degrees C.

F. Cables shall be tested for Crush Resistance, Impact resistance and Cyclic Flexing in accordance with FOTP-41, FOTP-25, and FOTP-104 respectively.

2.2 MANUFACTURERS

A. Anixter

B. Siecor

C. Or Equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Run fiber optic cable in conduit. Conduit system shall include 90 degree sweeping elbows in compliance with the manufacturer's minimum bend radius.

B. Contractor to coordinate cable and connector purchase with Instrumentation and Control System Supplier.

3.2 TAGS AND LABELS

A. Provide metal or flame-resistant adhesive label tags and identify the cable source, use and destination

END OF SECTION

SECTION 16483

ADJUSTABLE SPEED CONTROLLERS (ASC)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Detailed design, fabrication, installation, and testing of adjustable speed controller systems as scheduled and as shown on the drawings.

1.2 SUBMITTALS

A. SHOP DRAWINGS: Submit under the provisions of Section 01300. A reviewed set will be returned to the supplier for fabrication. The shop drawings shall include the following:
   1. Prior to shop drawing submittal for adjustable speed controller systems, obtain detailed motor load information from equipment manufacturer.
   2. Submit system hydraulic analysis including graphs and tabular information for the following:
      a. Input horsepower versus flow (minimum design flow to maximum design flow) taking into account pump, AFD and motor efficiencies.
      b. System curve versus pump curve at 100 percent speed and in 10 percent increments until minimum pump speed at which pump does not generate enough head to overcome static head is reached. Plots must also show curves of constant hydraulic horsepower to verify non-overloading.
      c. Tabulated data shall be calculated at 2 +percent speed increments.
   3. Submit harmonic voltage distortion analysis based upon the minimum three phase bolted fault short circuit current available at the point of service. Submittal data shall not relieve supplier of specified performance requirements. Analysis shall include:
      a. Calculate percent voltage distortion , with respect to fundamental voltage, for all harmonics up to the 48th.
      b. Comparison with IEEE 519 standards for acceptable voltage distortions on such systems.
   4. Submit detailed list of any proposed deviations from these specifications.
   5. Submit experience certification upon request including Owner name, address, and telephone number for systems of similar size and type.

B. OPERATION AND MAINTENANCE MANUALS: Include as part of the equipment operation and maintenance manual.

C. SPARE PARTS LIST: Provide vendor’s name, address, and phone numbers for spare parts.

1.3 PROJECT RECORD DOCUMENTS

A. Submit project record documents.

B. Submit harmonic distortion analysis test results showing actual field measurements of harmonic distortion.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products according to the written instructions of manufacturer.

1.5 WARRANTY

A. Provide two years of Manufacturer's warranty covering equipment, software, configuration, and labor from Owner's Acceptance.

1.6 GENERAL DESIGN REQUIREMENTS

A. This design is based upon the named manufacturer, if substitute equipment is offered, the contractor shall be responsible for all modifications including but not limited to components, interconnection wiring, space requirements, and equipment layout. All modifications shall be subject to approval by Engineer and provided at no additional cost to the Owner.

B. Like components of all systems, although for different service, shall be the end products of a single manufacturer.

C. It shall be the responsibility of the Contractor to provide a complete and fully operable adjustable speed controller system for each unit identified elsewhere in the specifications and on the drawings.

1.7 STANDARDS

A. IEEE Standards 519-1992.

B. UL listing/labeling Standard UL508C.

C. CSA

D. EMA ICS 3.1

E. Manufacturer shall be ISO 9001 or ISO 9002 certified.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Allen-Bradley, 18-pulse (Allen-Bradley, 6-pulse, if HP is less than 50).

B. Siemens, 18-pulse (Siemens, 6-pulse, if HP is less than 50).

C. Square-D, 18-pulse (Square-D, 6-pulse, if HP is less than 50).

2.2 GENERAL

A. Provide adjustable speed controller systems capable of converting the specified voltage, 3-phase, 60 Hz, input power into variable voltage, adjustable frequency, 3-phase output of suitable capacity and waveform to serve as input power to squirrel cage induction motors.

B. Harmonic Distortion:
   1. The adjustable speed controller systems shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when operated from the same bus.
   2. Individual or simultaneous operation of the adjustable speed controller systems shall not add more than 5 percent total harmonic voltage distortion to the normal bus, nor more than 10 percent while operating from the standby generator in accordance with IEEE 519, 1992.
   3. Maximum total and individual harmonic current distortion limits for each odd harmonic shall not exceed those set forth by IEEE 519, 1992.
   4. If harmonic filters are needed to meet these requirements, then the speed controller supplier shall provide and be responsible for the design and manufacture of the filters. The need for filters shall be identified by the Contractor in the Shop Drawings.

C. Reflected Wave/Harmonics:
   1. If the distance between the speed controller and the driven equipment requires cable terminators, they should be furnished by the speed controller supplier and installed by the contractor. The need for cable terminator(s) or reflected wave traps, shall be identified in the Shop Drawings.

2.3 ADJUSTABLE FREQUENCY DRIVE

A. Environmental
   1. Altitude: 3,300 feet without derating.
   2. Humidity: 5 to 95 percent, non-condensing.
   3. Temperature: 32 to 104 degrees Fahrenheit.

B. Electrical
   1. Input voltage tolerance: 10 percent of rated voltage.
   2. Rated voltage: as shown on drawings and scheduled.
   3. Input frequency: 48 to 62 Hertz.
   4. Displacement power factor: 0.95, provide inductor on units 5 hp and smaller.
   5. Efficiency at rated current and nominal voltage: 97.5 percent.
   6. Maximum short circuit current: 5000 A rms at 600 volts.

C. Control
   1. Method: Sine coded PWM with programmable carrier frequency.
   2. Output voltage: 0 to rated voltage.
   3. Output frequency: 0 to 400 Hz.
   4. Volts per Hertz ratio: fully programmable.

5. Frequency regulation:
    a. Analog input: 0.4 percent of maximum.
    b. Digital input: 0.01 percent of maximum.
6. DC Boost:
    a. Fan mode: two selectable.
    b. Auto mode: eight selectable with independent.
    c. Fixed mode: selectable with independent acceleration and run boosts.
7. Acceleration/deceleration: two independently programmable times, adjustable from 0 to 600 seconds in 0.1 second increments.
8. Intermittent overload capability.
    a. Constant torque: 150 percent of output for one minute.
    b. Variable torque: 115 percent of output for one minute.
9. Proactive current limit:
    a. Constant torque: 20 to 160 percent of rated output.
    b. Variable torque: 20 to 115 percent of rated output.
    c. Inverse time overload: Class 20 protection with speed sensitive response, adjustable from 20 to 115 percent of rated current in 3 speed ranges.

D. Protective features.
1. Detection and trip:
    a. Undervoltage.
    b. Overvoltage.
    c. Overcurrent.
    d. Overtemperature.
    e. External signal.
    f. Output short circuit.
    g. Ground fault.
2. Overcurrent stall.
3. Overvoltage stall.
4. Six alarms.

E. Signal interface:
1. Drive fault contact.
2. Drive run contact.
3. Drive alarm contact.
4. Programmable output contact.
5. Full Speed Command input.
6. Potentiometer input.
7. 0-10 VDC analog input.
8. 4-20 mA analog input.
9. 4-20 mA signal loss response.
10. Analog output, selectable.
11. Analog input conversion.
12. Pulse train input.
13. Encoder feedback closed loop speed control.

F. Programmable Parameters:
1. Dual acceleration/deceleration profiles.
2. Three skip frequencies.

3. DC injection braking.
4. Dynamic braking.
5. Slip compensation.
6. Negative slip compensation.
7. Selectable fault reset tries and time.
8. Electronic thermal overload.
9. S-curve acceleration/deceleration profile.
10. Standard and custom volts-per-hertz curves.
11. Traverse function.
12. Proactive current limit.
13. Four event fault memory.
14. Flying start.
15. Automatic DC boost.
16. Seven preset speeds.
17. Phase lock loop.

G. Human Interface Module- Keypad
1. Display faults in English language:
   a. Power fault.
   b. Control fault.
   c. Logic fault.
   d. Software fault.
   e. Protective fault.
2. Settings and indication
   a. Adjustable Speed/Constant Speed Selection (systems with bypass)
   b. Bypass Run Indication (systems with bypass)
   c. Manual/Automatic Selection
   d. Manual Pushbutton Start/Stop
   e. Speed Indication
   f. Speed Setpoint Indication
   g. Inverter Failure Indication
   h. Inverter Run Indication
   i. Manual Speed Control
   j. Alarm/Cutout Reset Switch
   k. Output Current Indication (each phase)
   l. Output Voltage Indication (each phase)
   m. Output Frequency Indication (each phase)
   n. Output Kilowatts Indication (each phase)
   o. Drive Temperature Indication
   p. Motor RPM Indication
3. Allow control of speed controller with start-stop function keys and digital speed potentiometers.
4. Allow programming of all programmable parameters.
5. Door mounted on front of enclosure. ASCs furnished as part of a motor control center (MCC), shall include an HMI keypad on cubicle door of the MCC. Provide required interface cable for either situation.

H. Constant or variable torque. Coordinate with the specification of the driven equipment.

2.4 OVERCURRENT PROTECTION

A. Provide thermal magnetic main circuit breaker of scheduled ampacity.

B. UL short circuit withstand rating shall be 42,000A minimum.

2.5 PILOT CONTROL DEVICES

A. Provide the following front of panel mounted pilot devices:
   1. Human interface Module.

B. Provide the following interface signals, prewired to terminal block for field connections:
   1. Remote START input.
   2. Remote TRIP input.
   3. Remote Full Speed Command input.
   4. Controller ON output.
   5. Controller in REMOTE control output.
   6. Controller FAILED output.
   7. Remote 4-20 mA speed demand input.
   8. 4-20 mA speed indication output.
   9. Motor shutdown protection (from auxiliary contact of disconnect switch local to motor).

2.6 ADDITIONAL REQUIREMENTS

A. The ASCs shall have an efficiency that exceeds 97% at 100% speed and load. The efficiency shall exceed 80% at 50% speed and load.

B. The ASCs shall maintain the line side displacement power factor no less then 0.95 regardless of speed and load.

C. The ASCs shall have a one minute overload current rating of 110% for Variable Torque Drives.

D. The ASCs shall have a one minute overload current rating of 150% for Constant Torque Drives.

E. The ASCs shall be able to start into a spinning motor. Each ASC shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the AFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the setpoint speed.

F. The ASCs shall have fully adjustable acceleration and deceleration controls.

G. The ASCs shall provide automatic phase rebalance to rebalance 3 phase load currents upset by voltage unbalance.

2.7 ENCLOSURE

A. 18 pulse shall be NEMA 1 or NEMA 12 floor mounted.

B. 6 pulse shall be NEMA 1 or NEMA 12 (wall or floor mounted).

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation by Others in accordance with written instructions from manufacturer in location shown on drawings.

B. Protect panels while construction is underway.

C. Clean panels and touch up paint when construction is complete.

D. Adjust overload devices.

E. Adjust all programmable controller features, including but not limited to auto restart parameters. The controller system must automatically restart after a power fail condition.

F. Provide engraved nameplates. Use equipment tag names shown on the plans. Refer to Section 16482.

G. Provide typed label inside each unit identifying motors served, nameplate horsepower, full load current, code letter, service factor, voltage/phase rating, and overload setting.

H. Provide typed label inside each unit identifying configured valves for all programmable drive parameters.

3.2 QUALITY CONTROL AND TESTING

A. Inspect and test each unit in accordance with NEMA ICS. 2, Division 16, and Vendor Manuals.

B. Prior to each drive application startup, all equipment shall be inspected for proper alignment and proper connection.

C. Short commercial tests shall be made, including no-load current at rated voltage, full load current, and locked rotor current.

D. Provide test of motor cables prior to energizing each new ASC. ASC manufacturer to provide test procedure.

E. Provide a pre-service test operation of the drive and motor in all normal modes of operation to test start, stop, jog, run, acceleration, and deceleration in local and remote modes.

F. Provide certified copies of test reports on each drive, to the Engineer for review.

3.3 TRAINING

A. The Contractor shall provide a training session for up to 4 Owner's representatives for 2 normal workdays with a maximum of 2 trips at a job site location determined by the Owner. Training and instruction time shall be in addition to that required for start-up services.

B. The training shall be conducted by the manufacturer's qualified representative.

C. The training program shall consist of the following:
1. Instructions on the proper operation of the equipment.
2. Instructions on the proper maintenance of the equipment.

END OF SECTION

SECTION 16510

LIGHTING FIXTURES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide and install lighting fixtures and related accessories as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Comply with the requirements of the following regulatory agencies;
   1. National Fire Protection Association (NFPA) Chapter 70 - National Electric Code (NEC) and Wisconsin Amendments thereto.
   2. Underwriters' Laboratories, Inc.(UL).
   3. Conform to the standards of the following agencies:
   4. National Electrical Manufacturers Association (NEMA).
   5. Certified Ballast Manufacturers Association (CBM).
   6. American National Standards Institute (ANSI), Standard C82.1.

1.4 SHOP DRAWING SUBMITTALS

A. Submit manufacturer's printed data on lighting fixtures.

B. Submit fixture shop drawings in booklet form with index and a separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with specified fixture and accessories clearly indicated on each sheet.

C. Shop drawings for all project light fixtures shall be submitted to the Engineer as a single submittal. It shall be the Contractor's responsibility to combine drawings from his different distributors to produce a single, complete submittal to the Engineer. Partial submittals will be rejected without review except that partial resubmittals of rejected fixtures will be allowed.

D. Submit copy of UL test report if requested by Engineer. Include the following information as a minimum:
   1. Dimensional information.
   2. Description of the fixture construction.
   3. Recommended lamps for use in that particular fixture.
   4. Photometric test reports.
   5. Any warnings regarding special requirements regarding the use of the lighting fixture.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURES

A. Provide lighting fixtures of the size, type, and rating indicated in "Lighting Fixture Schedule" complete with lamps, lampholders, reflectors, ballasts, starters, wiring and other equipment required for a complete working installation.

B. Fixture catalog numbers do not necessarily include all accessories required to complete the installation. Catalog numbers used in the Lighting Fixture Schedule are used to designate the fixture series, size and lamping requirements. Refer to the lighting fixture schedule notes for additional requirements.

C. Provide proper trim for each fixture as required for the various types of ceiling being installed throughout project. Provide the necessary plaster frames, fixture ends, caps, suspension units, mounting brackets, and/or other auxiliary parts required to complete the fixture installation.

2.2 FLUORESCENT FIXTURES

A. Fabricate from sheet steel, die-formed to provide rigidity.

B. The color finish of each surface or pendant mounted lighting fixture is to be verified with the Engineer at the time of shop drawing review.

C. Lens panels for fluorescent troffers shall be framed and be equipped with hinge and latch. Equip frames and louvers with retaining means to support frame during relamping.

D. Design fluorescent rapid start fixtures, 40W and smaller, to incorporate a grounded metal starting aid such as reflector, ballast channel strip, at least 1 in. wide over full length of lamp and within maximum ½ in. distance from lamp per ANSI C82.1.

E. Design fixtures such that case temperature of ballast does not exceed 90°C.

2.3 LENSES

A. Plastic fixture lenses and diffusers, 100% virgin acrylic material. Lenses minimum .125 average thickness.

2.4 STEMS

A. Where stems are furnished by fixture manufacturer, he shall verify length prior to releasing for shipment.

B. Where stems are furnished by Contractor, he shall verify length prior to installation.

C. Suspended fixtures shall have swivel type aligner hangers in ceiling outlet boxes to ensure plumb suspension.

D. Exit fixtures shall be installed so that line of sight is not obstructed.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which lighting fixtures are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Verify ceiling system compatibility with recessed fixture mounting before releasing the order for manufacture.

3.2 INSTALLATION

A. Install lighting fixtures of types indicated where shown on drawings and at indicated heights.

B. Install in accordance with manufacturer's written instructions.

C. Fasten fixtures securely to indicated structural support members.

D. Install pendant fixtures plumb.

E. Provide proper bushings for wire entrances. Ground fixture chassis to conduit system.

F. Coordinate with trades so lighting fixtures are properly aligned with items such as diffusers, grilles, and speakers. If necessary, relocate fixtures as directed so there will be no conflict with other equipment.

G. Mount stem mounted fixtures with swivel aligners and stem lengths as required. Verify stem lengths.

H. Make fixture holes for wire entrance with knock-out punches or hole saw, remove burrs. Do not cut holes with tin snips.

I. Care shall be taken in placement of outlets and surface-mounted fixtures to maintain alignment, spacings, layout, and general arrangement shown on drawings. Contractor may vary these dimensions slightly in order to clear obstructions. Any major changes in the arrangement must be approved by Engineer.

J. Align and plumb rows of light fixtures.

K. Mount wall and ceiling fixtures independent and secure so that they are not dependent on finish for support and cannot be rotated or displaced.

L. Maintain clearances as required in Section 410.66 of the NEC. Notify Engineer of any conflict, prior to rough in.

3.3 FIXTURE SUPPORTS

A. See Section 16190 for fixture support items such as devices procedures, and retaining clips.

B. Surface or pendant mounted lighting fixtures weighing in excess of 25 pounds shall be securely supported to the outlet box through the use of a fixture stud. The stud shall attach to the box through a knockout in the top of the box. Fixture support shall not be solely dependant on the ears of the box.

C. Securely attach outlet boxes to the building structure either directly to the structure or through the use a threaded rod or steel channel.

3.4 ADJUST AND CLEAN

A. Clean lighting fixtures of dirt and debris prior to acceptance. Cleaning shall include lamps, reflectors, lenses, louvers and exposed trims and housing.

B. Protect installed fixtures from damage during the construction period

C. Aim adjustable fixtures to satisfaction of Engineer. Adjustable exterior lighting fixtures, such as floodlights, shall be aimed after dark.

D. Remove conspicuous trade labels.

3.5 FIELD QUALITY CONTROL

A. At time of Substantial Completion, replace lamps in lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Engineer.

3.6 PRODUCT STORAGE AND HANDLING

A. Handle lighting fixtures carefully to prevent breakage, denting, and scoring finish.

B. Do not install damaged lighting fixtures.

C. Do not repair damaged fixtures; replace and return damaged units to equipment manufacturer for repair.

D. Store lighting fixtures in a clean, dry space. Store in original cartons and protect from dirt, physical damage, weather, and construction traffic.

3.7 JOB CONDITIONS

A. Contractor shall determine that ceiling suspension system is adequately supported to receive and support the lighting fixtures. Where deemed inadequate, do not install fixtures until additional support has been provided.

B. Verify local codes and ordinances that may pertain to installation and aiming of exterior fixtures. Notify Engineer prior to Bid time if problems are encountered.

END OF SECTION

SECTION 16621

AUTOMATIC TRANSFER EQUIPMENT

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 DESCRIPTION

A. Provide a factory assembled, metal enclosed, automatic transfer switch for distribution and control of power from normal power supply or from output of a standby engine/generator upon failure of normal power supply to outgoing feeder terminals and automatic retransfer back to normal power supply upon resumption of normal service.

1.3 QUALITY ASSURANCE

A. Equipment shall comply with the requirements of the following Regulatory Agencies:
   1. U.S. Environmental Protection Agency (EPA). Design criteria for Mechanical, Electrical, and Fluid System and Component Reliability.
   2. National Fire Protection Association (NFPA)
   3. Underwriters' Laboratories, Inc. (UL)
   4. Local Codes and Ordinances
   5. American National Standards Institute (ANSI)
   6. National Electrical Manufacturers Association (NEMA). Standard ICS.
   7. National Electrical Code (N.E.C.)
   8. Occupational Safety and Health Administration (O.S.H.A.)

B. Perform the following production tests on the completed transfer switch:
   1. Operation of individual components.
   2. Correct overall sequence of operation.
   3. Transfer time.
   4. Voltage.
   5. Time delay settings.
   6. Dielectric strength test per NEMA Standard ICS 1-109.05.

C. A prototype of the switch shall have been subjected to and have passed the following tests by a certified independent testing laboratory.
   1. Overload and endurance at 480 VAC per Table 21.2 and 23.2 of UL 1008 when enclosed per Table 1.6.

D. Provide with full rated neutral bar.

E. The switch shall have passed tests per paragraph 25 of UL 1008 to withstand current @ 480 VAC and X/R ratio of 6.6 or less using MCB upstream of the ATS.

F. The entire transfer switch and relay plate assembly should be capable of withstanding a 2500 volt crest transient per IEEE standard 472-1974. The transient voltage test shall be conducted across the normal source terminals, the emergency source terminals, and between opposite normal and emergency source terminals. A certified laboratory test report from an independent testing laboratory shall be furnished to verify conformance.

1.4 SUBMITTALS

A. Shop drawings shall indicate transfer switch, control panel and enclosure dimensions, control arrangements, and singleline diagrams in accordance with ANSI Y 32.2 indicating connections and controls.

B. Submit manufacturer's written recommendations for storage and protection, installation instructions, and field test requirements.

C. Submit manufacturer's instructions for start-up, performing cleaning, operating, and maintaining transfer switch systems.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Russelectric, Inc.

B. ASCO Series 7000

C. Engineer-approved equal.

2.2 TRANSFER SWITCH RATINGS

A. 600 Amp, 480Y/277 volt, 3 phase, 4 wire.

B. Switch shall be 4 pole. Switch shall be Closed-Transition style and shall be Service Entrance Rated.

C. Minimum Short Circuit Rating: 42,000 rms sym amps.

D. NEMA 12 enclosure.

E. Breaker shall be 100% rated and shall include a sensor plug and Micrologic (or equal) trip unit that includes LSI, residual ground fault, and ground fault trip.

2.3 EQUIPMENT SWITCH CONSTRUCTION

A. Transfer switch is to be mechanically held, electrically operated by a single solenoid or motor mechanism momentarily energized from the source to which the load is being transferred.

B. The switch shall be rated for continuous duty and shall be inherently double throw, mechanically interlocked to ensure only one of two possible positions, normal or emergency.

C. Load carrying parts shall have full 600-volt insulation and main contacts, as well as arcing contacts and shall be replaceable without disassembly of the operating mechanism or disconnection of power conductors.

D. The transfer switch shall consist of a power transfer module and a control module separately mounted. Control module shall be mounted on the inside surface of the enclosure door to facilitate safe adjustment and service. Harnessing between transfer module and control module shall have built-in disconnect.

E. The automatic transfer switch shall be suitable for use in emergency systems, listed by Underwriter's Laboratories under Standard 1008 for total system transfer.

F. Transfer switch shall be mounted in NEMA 1 enclosure (minimum). NEMA 4X if outdoor or in corrosive area.

G. The transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a non-ventilated enclosure constructed in accordance with Underwriters' Laboratories, Inc. Standard UL-508.

H. The transfer switch shall be double throw, actuated by two electrical operators momentarily energized and connected to the transfer mechanism by a simple over center type linkage with a total transfer time not to exceed ½ second. The transfer switches shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.

I. The normal and emergency contact shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contact shall be mechanically locked in position in both the normal and emergency positions without use of hooks, latches, magnets, or springs; and shall be silver tungsten alloy protected by arcing contacts with magnetic blowouts on each pole. Interlocked molded case circuit breakers or contactors are not acceptable.

J. The transfer switches shall be equipped with a manual operator per paragraph 14 of UL standard 1008 that is designed to prevent injury to the operating personnel if the electrical operator should suddenly become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electric operator to prevent a flashover from switching the main contacts slowly. The manual operator shall be designed to operate without opening the enclosure door. The switch assembly shall be designed such that manual operation will not put the person standing in front of it at risk of Arc Flash. A mechanical visual indicator for the switch position shall be provided.

K. All relay, timers, control wiring and accessories shall be front accessible. Test switch and pilot lights shall be on front of cabinet door. The voltage sensing relays and all adjustable times shall be capable of being adjusted while energized, through calibrated dials. All control wire terminals shall be ring or locking spade terminals.

L. All wiring shall be identified by tubular sleeve-type markers.

M. ARC FLASH WARNING LABELS

1. All transfer switches shall include a warning label indicating the risk of arc flash. The warning label shall comply with N.E.C. article 110.16 and O.S.H.A. 29.

2.4 ACCESSORIES

A. The control panel shall meet or exceed the voltage surge withstand capacity in accordance with IEEE Std. 472-1974 and impulse voltage withstand test in accordance with NEMA Std. ICS 1-109 and shall be supplied with the following accessories:

1. Engine starting contacts, gold plated for low voltage DC service. Contacts to close on failure of normal source to initiate engine starting.
2. Auxiliary contact to open when normal fails.
3. Independent voltage and frequency sensing network to prevent transfer to emergency until generator voltage is 90% of nominal and generator frequency is 95% of nominal.
4. Time delay on engine starting .5 to 3 second adjustable time delay to ignore momentary outages, factory set at 3 seconds.
5. Adjustable time delay on retransfer to normal (motor driven type - 0 to 30 minutes) fixed 5 minute unloaded running time for cool-down of stand-by plant after retransfer to normal.
6. Solid State Close Differential Relay protection on normal. Three Close Differential Sensing Relays factory set for 90% pickup, 80% dropout. Relays are adjustable in the field.
7. Test switch momentary type to be mounted on cabinet. Provides for testing operation of emergency plant and transfer switch (simulates normal power failure).
8. Green Pilot Light for indicating switch in normal position.
9. Red Pilot Light for indicating switch in emergency position.
10. Auxiliary Contact on main shaft (closed on normal).
11. Auxiliary Contact on main shaft (closed on emergency).
12. Assembly shall include an in-phase monitor/controller. The controller shall be bi-directional, operating independent of line voltage to assure transfer between live sources in either direction within a 20 degree phase angle difference (to protect system from abnormal motor inrush currents).

PART 3 EXECUTION

3.1 INSPECTION

A. Examine area to receive transfer switch to assure adequate clearance for transfer switch installation.

B. Start work only after unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install transfer switch in accordance with manufacturer's written instructions and NEC.

B. Contractor shall provide control wiring as required between transfer switch starting contacts and generator. Starting contacts for multiple transfer switches served from the same generator shall be wired in parallel. Control wiring shall be in conduit.

3.3 FIELD QUALITY CONTROL

A. Field Test Prior to Start-up.

B. Megger check of phase-to-phase and phase-to-ground insulation levels.

C. Continuity.

D. Do not megger check solid state equipment.

E. Perform tests according to transfer switch manufacturer's instructions.

3.4 ADJUSTMENTS AND CLEANING

A. Check adjustment of mechanism for free mechanical movement.

B. Tighten connections and mechanical fasteners.

C. Touch up scratched or marred surfaces to match original finish.

3.5 TRANSFER SWITCH START-UP

A. Retain services of transfer switch manufacturer's factory trained technician to perform following services:

B. After engine/generator load bank test and after engine/generator set is electrically connected to automatic transfer switch, provide comprehensive demonstration of system maintenance and operation to OWNER or OWNER'S maintenance personnel.

C. Include minimum of six simulated power failures.

3.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not store indoor type equipment exposed to weather.

B. Protect system equipment from work of other trades.

END OF SECTION

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SECTION 16960

TESTING ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 1 shall govern work under this Section.

1.2 SCOPE

A. Assure that electrical equipment is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.

B. Items To Be Tested
   1. Circuit Breakers
   2. Grounding Systems
   3. Remote instruments/sensors
   4. Auto Transfer Switch
   5. Motors
   6. Feeder Circuits
   7. Emergency Power Generator

1.3 QUALITY ASSURANCE

A. Comply with the requirements of the following regulatory agencies;
   1. National Fire Protection Association (NFPA), chapter 70 National Electrical Code (NEC) and Wisconsin amendments thereto.
   2. Underwriters' Laboratories, Inc. (UL).
   3. O.S.H.A.

B. Conform to the standards of the following agencies;
   1. National Electrical Manufacturer's Association (NEMA)
   2. American Society for Testing and Materials (ASTM)
   3. Institute of Electrical and Electronic Engineers (IEEE)
   4. National Electrical Testing Association (NETA)
   5. Insulated Power Cable Engineers Association (IPCEA)

C. Inspections and tests shall utilize the following references:
   1. Project design specifications.
   2. Project design drawings.
   3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.4 TEST REPORT SUBMITTALS

A. Complete testing report.

B. Submit report no later than 30-days after completion of testing.

1.5 JOB CONDITIONS

A. Responsibilities.
1. Supply a source of test power to test laboratory at each test site.
2. Coordinate work to minimize project delay.
3. Supply a complete set of electrical drawings, specifications, and pertinent change orders to testing contractor prior to commencement of testing.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Test work and equipment installed to ensure its proper and safe operation in accordance with intent of drawings and specifications.

B. Check interlocking and automatic control sequences and test operation of safety and protective devices.

C. Correct defects.

D. Cooperate with electrical utility, supplier's, and manufacturer's representatives in order to achieve proper and intended operation of equipment.

E. Test, adjust and record operating voltages at each system level before energizing branch circuits.

F. Transformer taps must be adjusted to obtain as near as possible nominal system voltage.

G. Where transformer is under utility jurisdiction, obtain services of utility to correct voltage.

H. Replace devices and equipment damaged due to failure to comply with this requirement.

I. Balance load among feeders conductors at each panelboard and power panel and reconnect loads as may be necessary to obtain a reasonable balance of load on each phase. Electrical unbalance shall not exceed 7½% between phases. Submit test results on the appropriate sheet found at the end of this section.

3.2 GROUNDING SYSTEMS

A. Inspect ground system for compliance with drawings and specifications.

B. Electrical Tests

1. Fall of Potential test per IEEE Standard No. 81, Section 9.04 on main grounding electrode or system.
2. Two Point Method test per IEEE Standard No. 81, Section 9.03, to determine ground resistance between main grounding system, and major electrical equipment frame, system neutral and/or derived neutral points.
3. Alternate to the Two Point Method.
    a. Ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point.
    b. This test shall be made by passing a minimum of 10-amp dc current between ground reference system and ground point to be tested.
    c. Voltage drop shall be measured and resistance calculated by voltage drop method.

3.3 FEEDERS

A. Each feeder shall be megger tested for insulation resistance.

B. Submit test results on the appropriate sheet found at the end of this section.

3.4 MOTORS

A. Motor testing shall be performed as specified in Section 16481.

B. Submit test results on the appropriate sheet found at the end of this section.

3.5 EMERGENCY POWER GENERATOR TESTING

A. Inspection
1. Examine room air intake and exhaust to assure adequate air requirements
2. Verify that mounting area is level and free of irregularities.
3. Clean equipment and equipment room prior to startup.

B. Starting Batteries and Charger
1. Locate freestanding battery rack near engine starter and connect cables with suitable lugs.
2. Wall mount battery charger near batteries and extend battery charging wires in conduit under floor.

C. Required Services
1. Retain services of engine/generator set trained technician employed by to perform following services:
    a. Installation Services.
        1) Visit project site to review installation requirements with Contractors involved. Visit shall be made prior to permanently installing equipment and/or making mechanical or electrical connections.
        2) Visit site and meet with all concerned Contractor s to ensure installation is properly coordinated. Electrical Contractor to coordinate meeting to ensure presence of all parties concerned.
    b. Testing Services.

1) In addition to normal factory tests, provide a 3-phase portable load bank at project site. Load bank test shall occur after equipment has been permanently installed and shall be performed in the presence of Engineer:
2) Connect engine/generator set to the load bank and conduct a 2-hr test
3) During two-hour test, vary load on generator from 10% to 100% to determine that voltage, frequency, capacity, fuel, combustion air, cooling, and ventilation systems are adequate. Step load during test as follows.
   a) 10% load for 15 min.
   b) 25% load for 15 min.
   c) 50% load for 15 min.
   d) 75% load for 15 min.
   e) 100% load for 30 min.
4) Apply each increment of load in one step.
5) During the test the following performance criteria shall be met.
6) Maximum voltage dip of 20%.
7) Recovery of less than 2 sec to maintain voltage and frequency as specified.
8) Submit release signed by supplier and Contractor to Owner and Engineer with deficiencies noted, if any, along with proposed solutions.
9) Include a minimum of two simulated power failures in the presence of transfer switch manufacturer's start-up representative.
10) Test remotely connected engine/generator status indication signals.
11) Test transfer switch.
12) Instructional Services. Provide a demonstration to Owner or maintenance personnel and Engineer of system maintenance and operation after load bank test and after engine/generator set is electrically connected to automatic transfer switch.

END OF SECTION

PANEL/TRANSFER SWITCH DESIGNATION_____

MEGGER TEST RESULTS

A-B Phase _____

B-C Phase _____

C-A Phase _____

A-Ground _____

B-Ground _____

C-Ground _____

Bolts Torqued _____

_____

Visual Inspection Comments:

Tested By _____

Date Tested _____

Time of Day _____

TRANSFORMER DESIGNATION_____

RESISTANCE LEVELS

A-B Phase _____

B-C Phase _____

C-A Phase _____

A-Ground _____

B-Ground _____

C-Ground _____

Primary Tap Settings _____

Secondary Tap Settings _____

Bolts Tightened

Visual Inspection Comments:

Tested By _____

Date Tested _____

Time of Day _____

FEEDER FROM _____ TO _____

Phase conductor size _____

Applied Voltage _____

Resistance Reading _____

Tested By _____

Date Tested _____

Time of Day _____

FEEDER FROM _____ TO _____

LOAD IN AMPS

Phase A _____

Phase B _____

Phase C _____

Phase conductor size _____

Tested By _____

Date Tested _____

Time of Day _____

Was Balancing Required? _____ Yes _____ No

ELECT MOTOR TAG # _____

HORSEPOWER _____

NAMEPLATE DATA:

Overload Relay Type _____

Protective Relay Setting _____

Voltage Readings (Motor Operating)

A-Phase _____

B-Phase _____

C-Phase _____

Current Readings (Motor Operating)

A-Phase _____

B-Phase _____

C-Phase _____

Direction of rotation (clockwise)(counterclockwise)

END OF SECTION

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IMPORTANT

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GILES ENGINEERING ASSOCIATES, INC.

Geotechnical Engineering Exploration and Analysis

Proposed Lift Station
1430 North Chicago Avenue
South Milwaukee, Wisconsin

Prepared for:

Applied Technologies, Inc.
Brookfield, Wisconsin

June 16, 2016
Giles Project No. 1G-1605002

GILES
ENGINEERING ASSOCIATES, INC.

GILES
ENGINEERING ASSOCIATES, INC.
GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

• Atlanta, GA
• Baltimore, MD
• Dallas, TX
• Los Angeles, CA
• Manassas, VA
• Milwaukee, WI

June 16, 2016

Applied Technologies, Inc.
16815 West Wisconsin Avenue
Brookfield, WI 53005

Attention: Mr. William A. Ericson
Project Manager

Subject: Geotechnical Engineering Exploration and Analysis
Proposed Lift Station
1430 North Chicago Avenue
South Milwaukee, Wisconsin
Giles Project No. 1G-1605002

Dear Mr. Ericson:

As requested, Giles Engineering Associates, Inc. ("Giles") conducted a *Geotechnical Engineering Exploration and Analysis* for the proposed project. The accompanying report describes the services Giles conducted, and it provides geotechnical-related findings, conclusions, and recommendations that were derived from those services.

We sincerely appreciate the opportunity to provide geotechnical services for the proposed project. Please contact the undersigned if there are questions about the report or if we may be of further service.

Very truly yours,

GILES ENGINEERING ASSOCIATES, INC.

Benjamin M. Stark, E.I.T.
Staff Professional I

David M. Cornale, P.E.
Sr. Geotechnical Consultant

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Attn: Mr. William A. Ericson (1 via email: waericson@ati-ae.com)

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PROPOSED LIFT STATION
1430 NORTH CHICAGO AVENUE
SOUTH MILWAUKEE, WISCONSIN
GILES PROJECT NO. 1G-1605002

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GEOTECHNICAL ENGINEERING EXPLORATION AND ANALYSIS

PROPOSED LIFT STATION
1430 NORTH CHICAGO AVENUE
SOUTH MILWAUKEE, WISCONSIN
GILES PROJECT NO. 1G-1605002

EXECUTIVE SUMMARY

This Executive Summary provides limited geotechnical information regarding the proposed project. Since this Executive Summary is exceedingly abbreviated, it must be read in complete context with the following report ("Report").

Site Development Considerations

- The existing lift station is at the site and it is understood this structure is to be removed. Site preparation must include complete and proper removal of the existing building, including all foundations, floor slabs, etc. Disposal of rubble and debris must be in accordance with local, state and federal regulations for the material type. Construction remnants that remain in-place could cause excavation difficulties for new utilities and landscape plantings, and for future construction. All excavations must be backfilled with engineered fill performed under engineering controlled conditions.

Subsurface Conditions

- Two test borings were conducted at the site using a mechanical drill-rig. Topsoil was at the surface of the test borings.
- Soil classified as fill was below the surface materials at the test borings and was present to approximately 6½ feet below the surface. At Test Boring No. 1, material classified as sandy silt with organic matter was present to 4 feet below the surface. Beneath the that fill material was silty fine to coarse sand and gravel. At test boring No. 2, the fill material consisted of silty fine to coarse sand and gravel.
- Native soil was below the fill and was present to the test-boring termination depths. In general, native soil consisted firm fine to medium sand to depths between ±9 and ±13 feet below-grade. Beneath the sand, gray silty clay was encountered to test boring termination depths. At both test borings, silty clay with gravel, cobbles and boulders was encountered approximately 3 to 3½ feet before test boring termination. The cobbles and boulders are likely the cause of auger refusal in Test Boring No. 2.
- It is estimated that the water table was about 7½ feet below-ground at the test boring locations, when the test borings were conducted.

Lift Station Housing Foundation

- A spread-footing foundation is recommended for the lift station housing. The foundations are recommended to be designed using a 2,000 psf maximum, net, allowable soil bearing capacity. Based on the test borings, footings can be supported by suitable bearing existing soil (existing fill or native) or new engineered fill used to replace unsuitable soils. However, the existing fill soil consisting of sandy silt, containing organic matter and encountered to a depth of 4± feet at Test Boring 1 is not considered suitable for foundation support and is recommended to be removed to suitable bearing subgrade.

The silty sand existing fill encountered below a depth of 4± feet at Test Boring 1 and below the topsoil at Test Boring 2 is anticipated to be suitable for foundation support, provide a risk increased settlement, beyond that estimated in this report is acceptable.

Lift Station Vault Foundation

- The proposed new lift station vault is recommended to be supported by a conventionally reinforced mat foundation. Suitable bearing native soils were encountered at Test Boring Nos. 1 and 2 at the planned bearing elevation of El. 612. The mat foundation, bearing within suitable bearing native soil, may be designed for a maximum, net, allowable bearing capacity of 3,500 psf or less. The mat foundation may be designed using a *Modulus of Subgrade Reaction* (K_s) value of 125 pounds per square inch per inch (psi/in). The actual mat foundation design, including dimensions and reinforcing, should be provided by the project structural engineer.

Housing Floor Slab

- The existing fill soil consisting of sandy silt, containing organic matter and encountered to a depth of 4± feet at Test Boring 1 is not considered suitable for floor slab support and is therefore recommended to be removed throughout the housing building are. Therefore, over-excavation is expected to be necessary for housing building floor slab construction.
- From a geotechnical perspective, floor slabs are recommended to be at least 4 inches thick. A minimum 4-inch-thick aggregate base course is recommended to be below the floor slabs. A vapor retarder is recommended to be continuous below the base course.

Lift Station Below Grade Design Parameters

- For the subsurface soil conditions encountered at the test borings, and regardless if a drainage system is constructed or not, values for the "at-rest" earth pressure coefficient of 0.56, and for an in-place bulk soil density of 132 pounds per cubic foot are recommended. Therefore, an equivalent fluid pressure of 101 pounds per cubic foot per foot depth (pcf/ft) is recommended for the buoyant soil plus hydraulic lateral pressure for below grade wall design. If a drainage system is used to keep the water table from rising above a predetermined level around the below-grade walls, an equivalent fluid pressure of 74 pounds per cubic foot per foot depth (pcf/ft) is recommended above the water level at the predetermined level.

GEOTECHNICAL ENGINEERING EXPLORATION AND ANALYSIS

PROPOSED LIFT STATION
1430 NORTH CHICAGO AVENUE
SOUTH MILWAUKEE, WISCONSIN
GILES PROJECT NO. 1G-1605002

1.0 SCOPE OF SERVICES

This report provides the results of the *Geotechnical Engineering Exploration and Analysis* that Giles Engineering Associates, Inc. ("Giles") conducted for the proposed development. The *Geotechnical Engineering Exploration and Analysis* included a Geotechnical Subsurface Exploration Program, Geotechnical Laboratory Services, and Geotechnical Engineering Services. The scope of each service area was narrow and limited, as directed by our client, and based on our understanding and assumptions about the proposed project. Service areas are briefly described later.

Geotechnical-related recommendations are provided in this report for design and construction of foundations and floor slabs for the proposed lift station. Site preparation recommendations are also given, but are only preliminary as the means and methods of site preparation will depend on factors that were unknown when this report was prepared. Those factors include, but are not limited to, the weather before and during construction, subsurface conditions that are exposed during construction, and final details of the project. Environmental-related consulting services were beyond Giles' scope for this project.

2.0 SITE AND PROJECT DESCRIPTION

The existing lift station is located at 1430 North Chicago Avenue in South Milwaukee, Wisconsin. A depiction of the site is shown on the *Test Boring Location Plan* (Figure 1), enclosed in Appendix A. The site is on the west side of North Chicago Avenue. Residential properties neighbor the site to the west and south. A stream borders the north side of the site. The existing lift station is on the western side of the site and a concrete driveway traverses the middle of the site and extends to the existing building. Topographically, the site was relatively flat; elevations at Test Boring Nos. 1 and 2 were El. 634 and El. 633.2, respectively. The first floor of the existing lift station is at El. 635.1. Those elevations are referenced to Giles' adopted benchmark shown on the *Test Boring Location Plan*.

3.0 PROJECT DESCRIPTION

A new lift station will be constructed to the north of the existing lift station. The existing lift station will be razed and removed. It is understood that the new lift station vault is estimated to bear approximately 22 feet below the ground, at approximately El. 612, based on the Geotechnical Investigation Request for Proposal, provided by Applied Technologies, Inc. (dated April 26, 2016). It is assumed that the lift station will be will be housed in a masonry structure that will have a conventional slab on grade. Also, it is assumed that the new lift station floor will be at the same elevation as the existing lift station (El. 635.1).

4.0 GEOTECHNICAL SUBSURFACE EXPLORATION PROGRAM

To explore subsurface conditions, two test borings were conducted at the site using a mechanical drill-rig. The test borings were performed on May 16, 2016. Test Boring No. 1 was north of the existing lift station and planned to be 36 feet deep, but was terminated at 31.5 feet due to auger refusal. Test Boring No. 2 was further north from Test Boring No. 1, and drilled to 36 feet, as planned. Both test boring locations were within the proposed lift station footprint. Test boring locations were positioned on-site relative to the existing lift station and other site features, and by estimating right angles. Approximate locations of the test borings are shown on the *Test Boring Location Plan*.

Samples were collected from each test boring, at certain depths, using the Standard Penetration Test (SPT), conducted with the drill rig. A brief description of the SPT is given in Appendix B along with descriptions of other field procedures. Immediately after sampling, select portions of the SPT samples were placed in containers that were labeled at the site for identification. Retained samples were transported to Giles' geotechnical laboratory. A Standard Penetration Resistance value (N-value) was determined from each SPT. N-values are reported on the *Test Boring Logs* (in Appendix A), which are records of the test borings.

The boreholes were backfilled, but settlement and/or expansion of backfill materials will likely occur, possibly creating a hazard that can lead to a threat of injury to people and animals. Borehole areas should, therefore, be carefully and routinely monitored by the property owner; settlement and/or expansion of backfill materials should be repaired immediately. Giles will not monitor or repair boreholes.

Ground elevations at the test borings were estimated by differential leveling, referenced to Giles' adopted benchmarks (the floor of the existing school) shown on the *Test Boring Location Plan*. Test boring elevations are noted on the *Test Boring Logs*, and are considered accurate within about 1 foot.

5.0 GEOTECHNICAL LABORATORY SERVICES

The retained samples were classified using the descriptive terms and particle-size criteria shown on the *General Notes* in Appendix D, and by using the Unified Soil Classification System (ASTM D 2488-75) as a general guide. The classifications are shown on the *Test Boring Logs*, along with horizontal lines that show estimated depths of material change. Field-related information pertaining to the test borings is also shown on the *Test Boring Logs*. For simplicity and abbreviation, terms and symbols are used on the *Test Boring Logs;* the terms and symbols are defined on the *General Notes*.

Calibrated penetrometer resistance, unconfined compression (without controlled strain), and moisture content tests were performed on select SPT samples to evaluate their general engineering properties. A grain size analysis and Atterberg Limit tests were performed on select cohesive samples that were representative of conditions. Because SPT samples were used, results of the unconfined compression (without controlled strain) and calibrated penetrometer tests are considered to be approximations and were used as supplemental information. The test results are on the *Test Boring Logs*. Grain size analysis results are shown on Figure 2. Laboratory procedures are briefly described in Appendix C.

6.0 MATERIAL CONDITIONS

Because material sampling at the test borings was discontinuous, it was necessary for Giles to estimate conditions between sample intervals. Estimated conditions at the test borings are briefly discussed in this section and are described in more detail on the *Test Boring Logs*. The conclusions and recommendations in this report are based only on the estimated conditions.

6.1. Surface Materials

Approximately 5 and 7 inches of topsoil were at the surface of the test borings.

6.2. Fill Material

Soil classified as fill was below the surface materials at the test borings and was present to approximately 6½ feet below the surface. At Test Boring No. 1, material consisting of sandy silt with organic matter was present to 4 feet. Beneath the sandy silty with organic matter was silty fine to coarse sand and gravel fill. At Test Boring No. 2, the fill material consisted of silty fine to coarse sand and gravel. Generally, the fill materials had loose to firm relative densities, based on N-values from SPT testing (reported on the *Test Boring Logs*).

6.3. Native Soil

Native soil was below the fill and was present to the test-boring termination depths. In general, native soil consisted firm fine to medium sand to depths between ±9 and ±13 feet below-grade. Beneath the sand, gray silty clay was encountered to test boring termination depths. At both test borings, silty clay with gravel, cobbles and boulders was encountered approximately 3 to 3½ feet before test boring termination. The cobbles and boulders are likely the cause of auger refusal in Test Boring No. 2. The silty clay exhibited medium stiff to hard comparative consistencies based on geotechnical laboratory testing and N-values from SPT testing (reported on the *Test Boring Logs*).

7.0 GROUNDWATER CONDITIONS

Based on the colors and moisture conditions of the recovered soil samples, it is estimated that the water table was about 7½ feet below-ground at the test boring locations, when the test borings were conducted. The groundwater table was estimated to be at approximately El. 626.5± and El. 625.5 ± at Test Boring Nos. 1 and 2, respectively, at the time of drilling. However, groundwater conditions will fluctuate and perched water conditions may develop as shallower depths, particularly within the existing fill soils.

The estimated groundwater and perched water depths are only an approximations based on the colors and relative water content of the retained soil samples, and water levels that were encountered at the test borings at the time of the subsurface exploration. The actual water table depth may be higher or lower than estimated. If a more precise depth estimate is needed, groundwater observation wells are recommended to be installed and observed at the site. *Giles* can install and observe the wells, if it is decided that observation wells are necessary.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1. Seismic Design Considerations

A soil Site Class C is recommended for seismic design. Site Class is based on the average properties of subsurface materials to 100 feet below the ground surface. Since 100-foot test borings were not requested or authorized for the project, it was necessary to estimate the Site Class based on the test borings, presumed area geology, and the International Building Code.

8.2. Housing Foundation Recommendations

A spread-footing foundation is recommended for the lift station housing. Based on the test borings, footings can be supported by suitable bearing existing soil (existing fill or native) or new engineered fill used to replace unsuitable soils. However, the existing fill soil consisting of sandy silt, containing organic matter and encountered to a depth of 4± feet at Test Boring 1 is not considered suitable for foundation support and is recommended to be removed to suitable bearing subgrade. The silty sand existing fill encountered below a depth of 4± feet at Test Boring 1 and below the topsoil at Test Boring 2 is anticipated to be suitable for foundation support, provide a risk increased settlement, beyond that estimated in this report is acceptable. The risk stems from the potential for unsuitable bearing existing fill to exist that could go undetected, which could result in foundation and floor slab settlements greater than those estimated herein. Reduction of the risk associated with the existing fill would require complete removal and replacement of the existing fill with structural compacted fill, which may also require construction dewatering, or other soil improvement methods. Considering the cost to

reduce the risk, the risk appears to be reasonable in our opinion with the recommended observation and testing during construction. If the risk is not acceptable to the owner, additional development costs would likely be needed to reduce the risk.

The foundations are recommended to be designed using a 2,000 psf maximum, net, allowable soil bearing capacity. For geotechnical considerations, strip footings are recommended to be at least 18 inches wide and isolated column pads are recommended to be at least 24 inches wide, regardless of the calculated foundation-bearing stress. Foundation walls for the addition could be constructed of cast-in-place concrete or concrete masonry units (CMUs). It is recommended and assumed that a structural engineer will provide specific foundation details including footing dimensions, reinforcing, and other details.

A minimum 48-inch foundation depth is required for frost protection. Footings for perimeter walls are, therefore, recommended to be at least 48 inches below the adjacent exterior grade, or to the depth required by the governing building code. Interior footings could be directly below the floor slab, since the addition will be heated and it is assumed that support soil will not freeze.

Foundation areas are recommended to be excavated with a smooth-edge bucket to develop a relatively undisturbed bearing grade. A toothed bucket will likely disturb foundation-bearing soil more than a smooth-edge bucket, thereby making materials at the excavation base more susceptible to saturation and instability, especially during adverse weather. Also, contractors must protect foundation support soil and foundation construction materials (concrete, reinforcing, etc.). In addition, engineered fill is recommended to be placed and compacted in excavations, benched as needed, along foundation walls immediately after the walls are capable of supporting lateral pressures from backfill, compaction, and compaction equipment.

Foundation Support Soil Requirements

Footings can bear directly on suitable existing fill that has been tested and approved by a geotechnical engineer. For the recommended 2,000 psf bearing capacity, the unconfined compressive strength of native cohesive (clayey) foundation support-soil is recommended to be at least 1.0 ton per square foot (tsf). For native non-cohesive (granular) soil, a minimum N-value (determined by the SPT and correlated from other tests) of 7 is recommended. It is further recommended that the strength characteristics of materials within the entire foundation influence zone (determined by a geotechnical engineer during construction) meet or exceed the recommended values, unless Giles approves lesser values.

In general, suitable-bearing soil was encountered below the sandy silty with organic matter, at a depth of 4± feet at Test Boring 1 and beneath the surface materials (topsoil) at Test Boring 2. Therefore, some over-excavation may be need for foundation construction. Due to the existing fill and because subsurface conditions could differ away from the test borings, a geotechnical engineer must evaluate (and approve) foundation support materials during foundation

excavation and immediately before foundation construction. The purpose of the recommended evaluation is to confirm that the foundations will be directly supported by suitable materials; to determine over-excavation depths and widths (if any), and to confirm that support materials are similar to those described herein and reported on the *Test Boring Logs*. If another firm performs the recommended evaluation, they should use appropriate means and methods and Giles must be notified if the composition or strength characteristics of foundation support materials differ from those shown on the *Test Boring Logs*, allowing us the opportunity to revise this report. Without evaluation and approval of foundation support materials by a geotechnical engineer, foundations could be improperly supported, possibly resulting in excessive settlement and distress of the proposed addition and damage to the existing building and other existing improvements.

Unsuitable materials beneath foundation areas could be replaced with engineered fill, such as well-graded aggregate. Depending on gradation, a geotextile might need to be installed to separate the fill material and existing soil. Also, if engineered fill is used as backfill, lateral over-excavation of the unsuitable materials will also be required, typically on a 2(vertical):1(horizontal) ratio extending down and outward from the bottom edges of the footing pads. To limit lateral over-excavation, unsuitable materials beneath foundation areas could be replaced with lean Portland cement concrete (minimum 28-day compressive strength of 500 psi). Lean concrete should be placed in trenches with near vertical sides, with excavation sidewalls at least 3 inches outside the lateral extent of footing pads. A geotechnical engineer should provide over-excavation and replacement recommendations at the time of construction.

Strip footing pads could be stepped or thickened to extend through unsuitable bearing materials and isolated column pads could be uniformly thickened or extended. It is recommended that a structural engineer provide specific details of stepped or thickened footings.

Estimated Foundation Settlement

The post-construction total and differential settlements of spread-footing foundations designed and constructed based on this report are estimated to be less than about 1 inch and 0.5 inch, respectively. The post-construction angular distortion is estimated to be less than about 0.002 inch per inch across a distance of 20 feet or more. Estimated settlements are based on the assumption that foundation support materials will be thoroughly tested and approved by a qualified geotechnical engineer during and immediately before foundation construction. A risk of increased settlement is considered to exist, if existing fill materials are left in-place below the floor slab.

8.3. Housing Floor Slab Recommendations

The existing fill soil consisting of sandy silt, containing organic matter and encountered to a depth of 4± feet at Test Boring 1 is not considered suitable for floor slab support and is therefore recommended to be removed throughout the housing building are. Therefore, over-excavation is expected to be necessary for housing building floor slab construction.

Following removal on the unsuitable organic containing fill materials and with proper subgrade preparation, existing site soil is expected to be suitable to support a ground-bearing floor slab for the lift station housing floor slab. However, evaluation (and approval) of floor-slab support materials by a geotechnical engineer during construction is critical. Assuming a maximum 100 psf floor load, the floor slab is recommended to be at least 4 inches thick; that recommended thickness assumes that the 28-day compressive strength of concrete will be at least 4,000 pounds per square inch (psi). The floor slab is recommended to be reinforced to help control shrinkage cracking. It is recommended that a structural engineer or architect specify the thickness, reinforcing, joint details, and other parameters.

A minimum 4-inch-thick base course is recommended to be below the floor slab to serve as a capillary break and for support considerations. It is recommended that the base course consist of free-draining aggregate that has been tested and approved by a geotechnical engineer. Depending on aggregate gradation, and subgrade conditions, a geotextile might need to be below the base course to serve as a separator.

A minimum 10-mil vapor retarder is recommended to be directly below the base course throughout the entire floor area. Abutting vapor retarder sheets are recommended to be overlapped and taped. Vapor retarders are recommended to be in accordance with ASTM E 1745-97, entitled: *Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs*, or other relevant documents. If the base course has sharp, angular aggregate, protecting the retarders with a geotextile (or by other means) is recommended.

Estimated Floor Slab Settlement

The post-construction total and differential settlements of an isolated floor slab constructed in accordance with this report are estimated to be less than about 0.5 inch and 0.3 inch, respectively, over a distance of about 20 feet. Estimated settlements are based on the assumption that floor slab support materials will be thoroughly tested and approved by a qualified geotechnical engineer during and immediately before floor slab construction. A risk of increased settlement is considered to exist, if existing fill materials are left in-place.

8.4. Lift Station Vault Foundation Recommendations

The proposed new lift station vault is recommended to be supported by a conventionally reinforced mat foundation. Suitable bearing native soils were encountered at Test Boring Nos. 1 and 2 at the planned bearing elevation of El. 612. The mat foundation, bearing within suitable bearing native soil, may be designed for a maximum, net, allowable bearing capacity of 3,500 psf or less. The mat foundation may be designed using a *Modulus of Subgrade Reaction* (K_s) value of 125 pounds per square inch per inch (psi/in). The actual mat foundation design, including dimensions and reinforcing, should be provided by the project structural engineer.

The state building code requires a minimum 48-inch foundation depth. Mat foundations should be at least 48 inches below the finished adjacent exterior ground surface. It is expected this requirement will be met since the bottom of the lift station vault is planned to be at least 22± feet below the finished grade.

Contractors are recommended to protect foundation materials, including concrete, reinforcing, and foundation support soil during and after construction. Where the foundation is not immediately cast after excavation and verification of suitability for support, a 3 to 4-inch-thick mud slab at the base of foundation excavation is recommended to serve as a working mat for construction activities and to protect foundation support soil. Mud slab construction at the base of the foundation excavation should begin immediately after a geotechnical engineer tests the underlying soil and confirms that the soil can support the foundation.

The foundations are recommended to be directly supported by suitable bearing soil. Soils suitable for direct foundation support or as the subgrade for engineered fill to replace unsuitable bearing soil and indirect foundation support are recommended to have, within the foundation influence zone, at least a stiff comparative consistency (average unconfined compressive strength greater than or equal to 1.75 tsf) for clayey soils, and an average corrected N-value equal to or greater than 12 for non-cohesive sandy foundation support soils, based upon the recommended 3,500 psf maximum, net allowable bearing capacity at the lift station vault. The bearing suitability of the foundation grade and the engineered fill subgrade are recommended to be tested prior to foundation construction. The purpose of the recommended bearing suitability testing is to confirm that the foundation will be properly supported and confirm that the support soil is similar to the conditions described on the *Test Boring Logs*. In the event that another firm performs the recommended foundation evaluation of foundation support soil, they should use appropriate means and methods and Giles must be notified if the composition or strength characteristics of foundation support soil differ from those shown on the *Test Boring Logs* so that alterations to the recommendations can be made if needed.

Suitable bearing native soil is anticipated to be present at the planned 22-foot foundation bearing depth (El. 612) for the proposed lift station vault, at the test boring locations. The actual suitable bearing grade or engineered fill subgrade may vary from the anticipated suitable

bearing grade beyond the test boring location, and the depth of the suitable bearing grade or subgrade should be determined based on evaluation and testing by a Giles representative at the time of construction. If unsuitable bearing grade soils are encountered, additional depth of excavation to suitable bearing soils is recommended. Soil that is within the foundation influence zone but does not meet the recommended strength criteria described above, or is otherwise unsuitable, is recommended to be replaced. Unsuitable bearing soil is recommended to be replaced with engineered fill such as lean-mix Portland cement concrete with a minimum 28-day compressive strength of 500 psi. In order to use lean mix concrete backfill, the over-excavation is recommended to extend at least 6 inches laterally beyond the sides of the footing, and the material must cure prior to foundation construction.

The post-construction total and differential settlements of a mat foundation designed and constructed based on the recommendations of this report are estimated to be less than about 1.0 inch and 0.5 inch, respectively. The post-construction angular distortion is estimated to be less than about 0.002 inch per inch across a distance of 20 feet or more. Estimated settlements are based on the assumption that soils will be tested and approved by a licensed qualified geotechnical engineer during foundation construction.

8.5. Lift Station Below-Grade Design Parameters

The lift station vault is recommended to be designed as a "water tight" structure to reduce groundwater infiltration into the structure, and should be designed to resist hydrostatic pressures. The below-grade structure must be designed to withstand any hydrostatic lateral and uplift pressures, as well as lateral pressure for adjacent soil and any surcharge load.

The mat foundation slab or the perimeter strip spread foundation bottom slab, and the below-grade walls of the proposed lift station replacement are recommended to be designed to resist hydrostatic uplift and lateral pressures. The uplift and lateral pressures are recommended to be based on a water level El. 628±, which is approximately 2 feet above the average water level encountered at the test borings at the time of drilling. The groundwater table at the time of the test boring exploration on May 16, 2016 was considered to exist at approximately 7½ feet below the surface of the test borings.

It is not considered practical to attempt to depress the water table below the bottom of the lift station vault for a long term due to the depth differential and the probable volume of water needed to be removed. Therefore, the lift station vault is recommended to be designed to resist hydrostatic uplift and lateral pressures. If an open excavation method is used for construction of the pump station upgrade, a pump and drainage system could be placed around the exterior perimeter of the structure, to keep the water table from rising above a predetermined level. The determination of the actual depth of the drainage system should be based on a cost-benefit analysis relative to structural design and deadweight issues. If used, the pumps should be equipped with generator or battery back-up systems to reduce water problems in the event of a power failure.

Hydrostatic uplift may be resisted by the dead weight of the structure. The structural design of the walls should also be used to offset the lateral pressure. Live loads should not be used to determine uplift resistance. The water that the lift station will hold should also not be used to resist uplift if the water will be removed from the lift station at some time; and components within the structure that may be removed in the future should not be included in determining uplift resistance. The effective weight of the entire structure could be increased by the weight of the backfill soil placed above a collar or extended foundation mat surrounding the structure, provided that the collar or mat is suitably tied into the below grade walls. A buoyant weight of 47 pounds per cubic foot may be used for the backfill above the collar or mat and extending to the finished ground surface. If a drainage system is used to control the water level surrounding the exterior of the lift station at some predetermined elevation, backfill above the predetermined elevation can be assumed to have an in-place density of 110 pounds per cubic foot. For sustained uplift, the volume of soil can be determined by a vertical line extending from the exterior edge of the foundation to the ground surface. For transient uplift, the volume can be determined by a line extending from the exterior edge of the ground surface on a 20-degree angle from vertical.

A non-woven geotextile is recommended to line the excavation and placed over the drainage backfill to provide separation and to serve as a filter and separator against migration of the in-place and overlying soils into the voids of the drainage system backfill. The geotextile is recommended to be in accordance with WDOT Section 645, Type DF, non-woven. Backfill for the below-grade structures designed for uplift and lateral pressures from soil and water is recommended to consist of granular material which is in accordance with Wisconsin Department of Transportation (WDOT) Standard Specifications for Road and Bridge Construction Section 310 (Open-Graded Aggregate), Section 305 (Dense Graded Base), or Section 209 (Granular Backfill), or as approved by the geotechnical engineer. The backfill is recommended to be placed throughout the area of the excavation. Backfill that is placed adjacent to below-grade structure and will also provide structural support should be compacted under the observation of a geotechnical engineer. Compaction of the backfill is recommended to achieve a density of between 92 and 95 percent of the maximum dry density by the Standard Proctor Compaction test and light hand-operated compaction equipment is recommended so that excessive stress is not subjected to the walls. Structures are recommended to be braced during construction, backfilling, and compaction, as necessary. A minimum 6-inch-thick clay cap, pavement, or other impermeable surface material, sloped away from the structure, should be placed above the granular wall backfill material to reduce surface water intrusion and promote drainage away from the structure.

The below-grade walls of the lift station replacement structure are recommended to be designed for the "at-rest" lateral earth pressure. For the subsurface soil conditions encountered at the test borings, and regardless if a drainage system is constructed or not, values for the "at-rest" earth pressure coefficient of 0.56, and for an in-place bulk soil density of 132 pounds per cubic foot are recommended. Therefore, an equivalent fluid pressure of 101 pounds per cubic foot

per foot depth (pcf/ft) is recommended for the buoyant soil plus hydraulic lateral pressure for below grade wall design. If a drainage system is used to keep the water table from rising above a predetermined level around the below-grade walls, an equivalent fluid pressure of 74 pounds per cubic foot per foot depth (pcf/ft) is recommended above the water level at the predetermined level. Lateral pressure from any surcharge load next to the lift station structure is recommended to be based on multiplying the surcharge pressure by the "at-rest" earth pressure coefficient of 0.56.

The lateral pressure design parameters are for relatively level ground surfaces adjacent to the replacement lift station structure. If a ground surface slope is planned, the recommended design parameters will need to be adjusted for the planned slope.

8.6. Generalized Construction Considerations

This section deals with site preparation including preparation of floor slab, pavement, and engineered fill areas. The means and methods of site preparation will greatly depend on the weather conditions before and during construction, the subsurface conditions that are exposed during earthwork operations, and the final details of the proposed development. Therefore, only generalized site preparation recommendations are given.

In addition to being general, the following site preparation recommendations are abbreviated; the *Guide Specifications* in Appendix D gives further recommendations. The *Guide Specifications* should be read along with this section. Also, the *Guide Specifications* are recommended to be used as an aid to develop the project specifications.

Demolition and Removal

The existing lift station is at the site and it is understood this structure is to be removed. Site preparation must include complete and proper removal of the existing building, including all foundations, floor slabs, etc. Disposal of rubble and debris must be in accordance with local, state and federal regulations for the material type. As an option to complete removal (outside the proposed building area), it may be feasible for existing foundations to remain in-place outside of the planned lift station area, provided the foundations are stable, are cut off at least 3 feet below the planned subgrade, and any hollow cores are grouted solid. However, construction remnants that remain in-place could cause excavation difficulties for new utilities and landscape plantings, and for future construction. All excavations must be backfilled with engineered fill performed under engineering controlled conditions. It is also expected to be necessary to bench into the surrounding soils, as noted in Item No. 3 of the *Guide Specifications* enclosed in Appendix D. Care must be taken not to damage the remaining school building during the demolition and removal operations.

Existing pavement is recommended to be saw-cut (where needed) and removed from the development areas. Removed pavement could be pulverized into a well-graded material with a maximum 3-inch particle size and used as fill, subbase material, or subgrade stabilization material. After removal of the existing pavement, base course materials should then be removed, if needed, to meet grade requirements. Base course materials could be stockpiled on-site for future use as fill material, subbase material, or subgrade stabilization material. Existing base course materials that are removed and stockpiled could possibly be re-used as base materials for any new pavement after the subgrade is properly prepared and confirmed to be suitable. A geotechnical engineer must, however, test and approve stockpiled base course materials before reuse. If existing base course materials are reused for new pavement, the pavement sections given above might need to be thicker than recommended to account for a lower structural coefficient. Giles must be notified if the existing base materials will be reused. Existing pavement and base material should be left in-place as long as possible to help protect the underlying soil, which is sensitive to moisture and disturbance.

Surface vegetation, trees and bushes, topsoil with adverse organic content, and otherwise unsuitable bearing materials are recommended to be removed from the proposed addition footprint, new pavement areas, and other structural areas. Clearing, grubbing and stripping should extend at least several feet beyond proposed development areas, where feasible.

Engineered Fill/Backfill Placement

After the recommended clearing, grubbing and stripping, the site is recommended to be raised, where necessary, to the planned finished grade with engineered fill immediately after the sub-grade is confirmed to be stable and suitable to support the proposed improvements. Engineered fill and backfill is recommended to be placed in uniform, relatively thin layers (lifts). And, each layer of engineered fill is recommended to be compacted to at least 95 percent of the fill material's maximum dry density determined from the geotechnical test titled: *Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort* (ASTM D698). That test is hereafter referenced as: *The Standard Proctor Compaction test*. Item Nos. 4 and 5 of the *Guide Specifications* give more information pertaining to selection and compaction of engineered fill.

The water content of fill material is recommended to be uniform and within a narrow range of the optimum moisture content, as described in Item No. 5 of the *Guide Specifications*. The optimum moisture content is to be determined by the Standard Proctor Compaction test.

Engineered fill that does not meet the density and water content requirements is recommended to be replaced or scarified to a sufficient depth (likely 6 to 12 inches, or more), moisture-conditioned, and compacted to the required density. A subsequent lift of fill should only be placed after *Giles* confirms that the previous lift was properly placed and compacted. Sub-grade soil may need to be recompacted immediately before construction since equipment traffic and adverse weather may reduce soil stability.

Use of Site Soil as Engineered Fill/Backfill

Site soil that does not contain adverse organic content or other deleterious materials, as noted in the *Guide Specifications,* could be used as engineered fill. Considering the measured water contents of the tested soil samples, site soil is expected to require moisture-conditioning prior to use as engineered fill. If construction is during adverse weather (discussed in the following section), drying site soil will likely not be feasible. In that case, aggregate fill (or other fill material with a low water-sensitivity) will likely need to be imported to the site. Additional recommendations regarding fill selection, placement and compaction are given in the *Guide Specifications*.

Adverse Weather

Site soil is moisture sensitive and will become unstable when exposed to adverse weather such as rain, snow, and freezing temperatures. Therefore, it might be necessary to remove or stabilize the upper 6 to 12 inches (or more) of soil due to adverse weather, which commonly occurs during late fall, winter, and early spring. At least some over-excavation and/or stabilization of unstable soil should be expected if construction is during or after adverse weather. Because site preparation is weather dependent, bids for site preparation, and other earthwork activities, should consider the time of year that construction will be conducted.

In an effort to protect soil from adverse weather, the site surface is recommended to be smoothly graded and contoured during construction to divert surface water away from construction areas. Foundation construction should begin immediately after suitable support is confirmed.

Dewatering

It is estimated that the groundwater table was approximately 7.5± feet below the surface when the Geotechnical Subsurface Exploration Program was conducted. Based on the provided lift station vault foundation depth and the encountered groundwater levels, it is expected that excavations for construction of the lift station will be below the groundwater table. Accordingly, dewatering to lower the groundwater table, and thereby control groundwater inflows to the excavations and/or assist in stabilizing subgrade soils, is anticipated to be needed. Specialized dewatering techniques, such as deep wells, vacuum wells possibly also with sheeting, or casing for a drilled wet well, are expected to be needed for groundwater control during construction.

Dewatering should be started prior to excavation below the water table and should continue until all earthwork operations, foundation construction, utility construction, below-grade wall construction and backfilling have extended above the water table. Dewatering is expected to be needed where excavations extend below the groundwater table to prevent "boiling" and/or

"heaving" of the subgrade soils. Vibratory compaction methods are not recommended near the water table since a "quick" or "boiling" condition could develop. A geotechnical engineer should review and approve dewatering methods.

Some dewatering might also be needed during construction due to precipitation or if shallower perched water is encountered. Water that accumulates in construction areas is recommended to be removed from excavations and other construction areas, along with unstable soil as soon as possible. Filtered sump pumps, drawing water from sump pits excavated in the bottom of construction trenches, will likely be adequate to remove water that collects in shallow excavations above the groundwater table. Excavated sump pits should be fully-lined with a geotextile and filled with open-graded, free-draining aggregate.

Excavation Stability

Excavations are recommended to be made in accordance with current OSHA excavation and trench safety standards, and other applicable requirements. Sides of excavations will need to be sloped or braced to maintain or develop a safe work environment. Temporary shoring must be designed according to applicable regulatory requirements. Contractors are responsible for excavation safety.

Sloping of excavation side walls or the use of temporary shoring is expected to be needed to maintain stable excavations. Therefore, anticipated excavation widths and the potential impacts of construction excavation on the existing site developments are recommended to be considered in determining the specific lift station locations.

Utility Considerations

Utilities associated with the existing and adjacent developments are located at the site. The excavations for utilities to be removed that are in the influence zone of new construction are recommended to be backfilled with engineered fill placed under engineering controlled conditions. Underground utilities that are to be reused should be evaluated by the structural engineer or civil engineer, and utility backfill should be evaluated by *Giles*, to determine their potential effect on the new development. Grading operations must be done carefully so that existing utilities are not damaged or disturbed.

8.7. Recommended Construction Materials Testing Services

This report was prepared assuming that a geotechnical engineer will perform Construction Materials Testing ("CMT") services during construction of the proposed development. It might be necessary for Giles to provide supplemental geotechnical recommendations based on the results of CMT services and specific details of the project not known at this time.

8.8. Basis of Report

This report is strictly based on the project description given earlier in this report. Giles must be notified if any parts of the project description or our assumptions about the proposed project are not accurate so that this report can be amended, if needed. This report is based on the assumption that the facility will be designed and constructed according to the codes that govern construction at the site.

The conclusions and recommendations in this report are based on estimated subsurface conditions as shown on the *Test Boring Logs*. Giles must be notified if the subsurface conditions that are encountered during construction of the proposed development differ from those shown on the *Test Boring Logs* because this report will likely need to be revised. General comments and limitations of this report are given in the appendix.

The conclusions and recommendations presented in this report have been promulgated in accordance with generally accepted professional engineering practices in the field of geotechnical engineering. No other warranty is either expressed or implied

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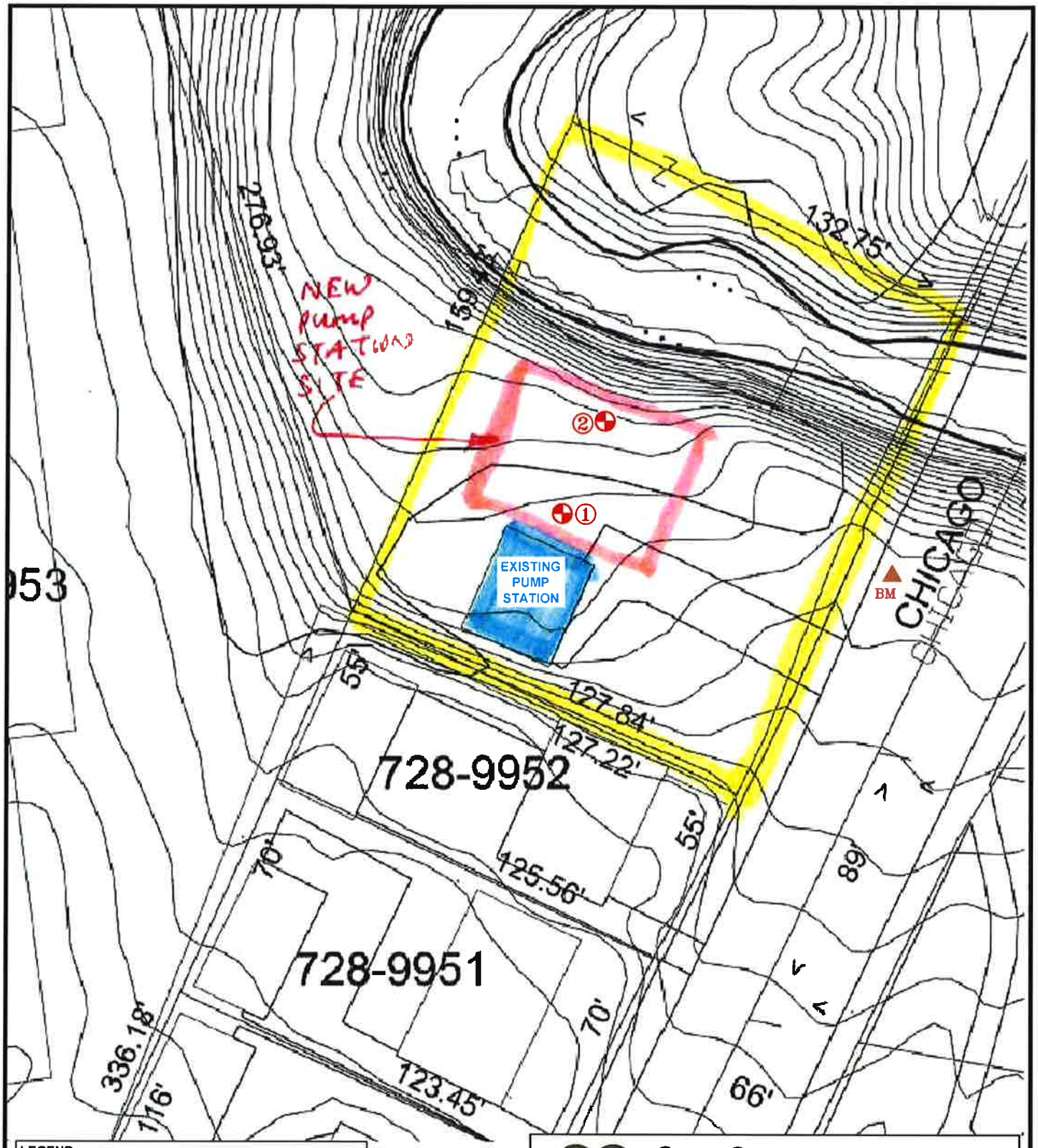
1G-1605002/16Geo02/Geo/bms/etk

APPENDIX A

FIGURES AND TEST BORING LOGS

The Test Boring Location Plan contained herein was prepared based upon information supplied by *Giles'* client, or others, along with *Giles'* field measurements and observations. The diagram is presented for conceptual purposes only and is intended to assist the reader in report interpretation.

The Test Boring Logs and related information enclosed herein depict the subsurface (soil and water) conditions encountered at the specific boring locations on the date that the exploration was performed. Subsurface conditions may differ between boring locations and within areas of the site that were not explored with test borings. The subsurface conditions may also change at the boring locations over the passage of time.



LEGEND:

① GEOTECHNICAL TEST BORING

BM BENCHMARK: MANHOLE. ASSUMED ELEVATION = 636.3'

NOTES:

1.) TEST BORING LOCATIONS ARE APPROXIMATE.

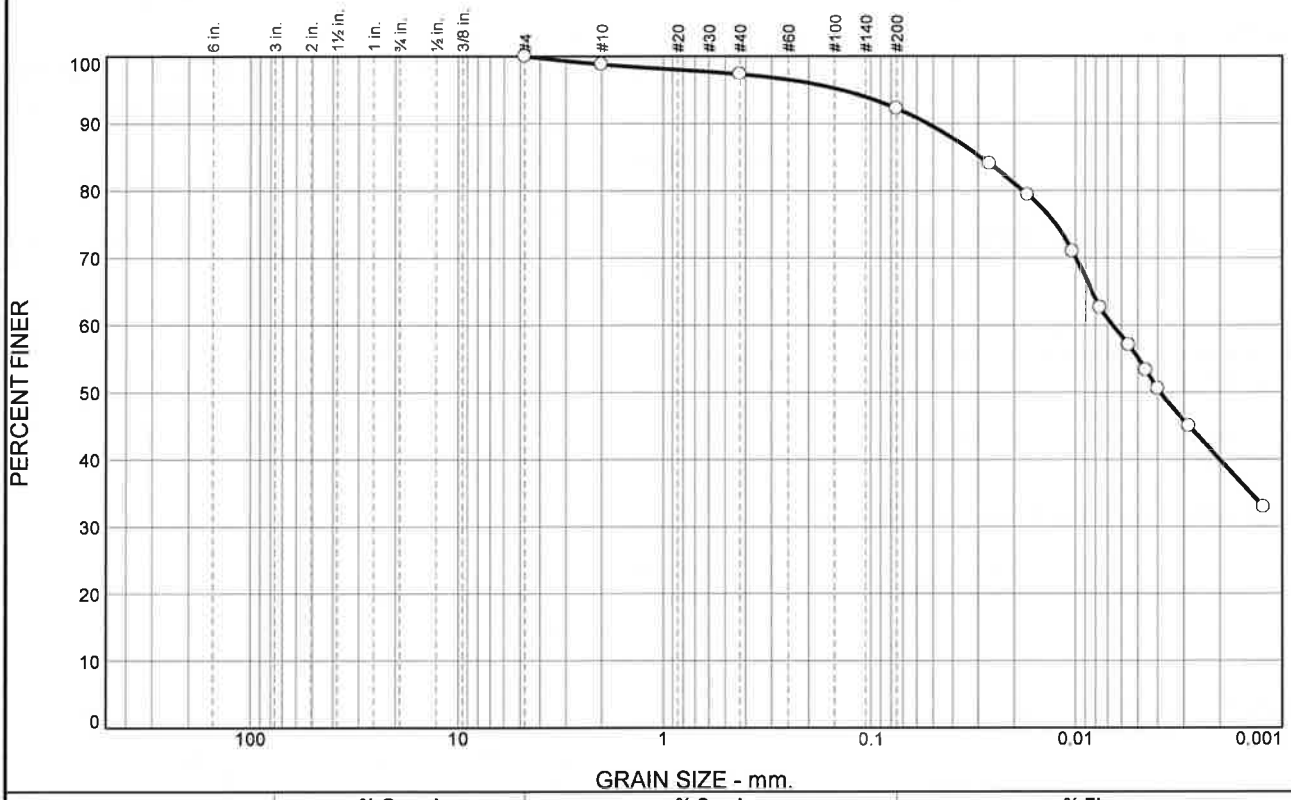
2.) BASE MAP DEVELOPED FROM A SITE PLAN, PROVIDED BY THE CLIENT.

GILES ENGINEERING ASSOCIATES, INC.
N8 W22350 JOHNSON DRIVE, SUITE A1
WAUKESHA, WI 53186 (262)544-0118

FIGURE 1
TEST BORING LOCATION PLAN
PROPOSED LIFT STATION
1430 NORTH CHICAGO AVENUE
SOUTH MILWAUKEE, WISCONSIN

DESIGNED	DRAWN	SCALE	DATE	REVISED
BMS	JSZ	approx. 1"=40'	06-16-16	--
PROJECT NO.: 1G-1605002			CAD No. 1g1605002-blp	

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.2	1.5	5.1	37.0	55.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	98.8		
#40	97.3		
#200	92.2		

* (no specification provided)

Material Description

Silty Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0533 D_{85}= 0.0294 D_{60}= 0.0066
D_{50}= 0.0039 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

F.M.=0.13

Source of Sample: Boring No. 2 **Depth:** 19 1/2-21 ft.
Sample Number: SS-7

Date: 6/7/2016

GILES ENGINEERING ASSOC., INC.
Waukesha, Wisconsin

Client: Applied Technologies, Inc.
Project: North Chicago Lift Station

Project No: 1G-1605002 **Figure:** 2

BORING NO. & LOCATION: 1	TEST BORING LOG	GILES ENGINEERING ASSOCIATES, INC.
SURFACE ELEVATION: 634 feet	PROPOSED LIFT STATION	
COMPLETION DATE: 05/16/16	1430 NORTH CHICAGO AVENUE SOUTH MILWAUKEE, WISCONSIN	
FIELD REP: KEITH FLOWERS	PROJECT NO: 1G-1605002	

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
5"± Topsoil			1-SS	4		2.0		21		
Fill: Dark Brown Sandy Silt, little Organic Matter - Moist			2-SS	28		2.8		27		
		630								
Fill: Brown Silty fine to coarse Sand and Gravel - Moist	5		3-SS	8						
Brown fine to medium Sand, little Silt - Wet			4-SS	9						
		625								
Gray fine to medium Sand, little Silt - Wet	10		5-SS	13						
		620								
Gray Silty Clay - Wet (Includes Silty Sand lenses)	15		6-SS	12	1.3	1.9		22		
		615								
	20		7-SS	14				19		
		610								
	25		8-SS	17	6.6	4.5+		15		
		605								
	30		9-SS	25		1.8		18		LL=34 PI=18 P2002 35%
Gray Silty Clay, little Gravel -Wet (contains Cobbles and/or Boulders)		600								
	35		10-SS	50/4"		3.7		11		
Boring Terminated at about 36 feet (EL. 598')										

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling: 7.5 ft.	
▼	Water Level At End of Drilling: 11 ft.	
	Cave Depth At End of Drilling: 12 ft.	
▼	Water Level After Drilling:	
	Cave Depth After Drilling:	

GILES LOG REPORT 1G1605002.GPJ GILES.GDT 6/16/16

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION: 2	TEST BORING LOG	GILES ENGINEERING ASSOCIATES, INC.
SURFACE ELEVATION: 633.2 feet	PROPOSED LIFT STATION	
COMPLETION DATE: 05/16/16	1430 NORTH CHICAGO AVENUE SOUTH MILWAUKEE, WISCONSIN	
FIELD REP: KEITH FLOWERS	PROJECT NO: 1G-1605002	

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
7"± Topsoil			1-SS	5	4.3	3.9		14		
Fill: Brown Silty fine to coarse Sand and Gravel - Moist			2-SS	8						
		630	3-SS	11						
	5									
Gray fine to medium Sand, little Silt - Wet		625	4-SS	13						
Gray Silty Clay - Wet	10		5-SS	12		4.1		20		
		620								
	15		6-SS	15	2.3	2.3		17		
		615								
	20		7-SS	22	3.6	4.0		18		
		610								
	25		8-SS	28						No Sample Recovery
Gray Silty Clay, little Gravel - Wet (contains Cobbles and/or Boulders)		605								
	30		9-SS	50/5"	5.8	4.5+		12		
Auger Refusal Boring Terminated at about 31.5 feet (EL. 601.7')										

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling: 7.5 ft.	
▼	Water Level At End of Drilling:	
	Cave Depth At End of Drilling: 12 ft.	
▼	Water Level After Drilling:	
	Cave Depth After Drilling:	

GILES LOG REPORT 1G1605002.GPJ GILES.GDT 6/16/16

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

APPENDIX B

FIELD PROCEDURES

The field operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) designation D

420 entitled "Standard Guide for Sampling Rock and Rock" and/or other relevant specifications. Soil samples were preserved and transported to *Giles'* laboratory in general accordance with the procedures recommended by ASTM designation D 4220 entitled "Standard Practice for Preserving and Transporting Soil Samples." Brief descriptions of the sampling, testing and field procedures commonly performed by *Giles* are provided herein.

GENERAL FIELD PROCEDURES

Test Boring Elevations

The ground surface elevations reported on the Test Boring Logs are referenced to the assumed benchmark shown on the Boring Location Plan (Figure 1). Unless otherwise noted, the elevations were determined with a conventional hand-level and are accurate to within about 1 foot.

Test Boring Locations

The test borings were located on-site based on the existing site features and/or apparent property lines. Dimensions illustrating the approximate boring locations are reported on the Boring Location Plan (Figure 1).

Water Level Measurement

The water levels reported on the Test Boring Logs represent the depth of "free" water encountered during drilling and/or after the drilling tools were removed from the borehole. Water levels measured within a granular (sand and gravel) soil profile are typically indicative of the water table elevation. It is usually not possible to accurately identify the water table elevation with cohesive (clayey) soils, since the rate of seepage is slow. The water table elevation within cohesive soils must therefore be determined over a period of time with groundwater observation wells.

It must be recognized that the water table may fluctuate seasonally and during periods of heavy precipitation. Depending on the subsurface conditions, water may also become perched above the water table, especially during wet periods.

Borehole Backfilling Procedures

Each borehole was backfilled upon completion of the field operations. If potential contamination was encountered, and/or if required by state or local regulations, boreholes were backfilled with an "impervious" material (such as bentonite slurry). Borings that penetrated pavements, sidewalks, etc. were "capped" with Portland Cement concrete, asphaltic concrete, or a similar surface material. It must, however, be recognized that the backfill material may settle, and the surface cap may subside, over a period of time. Further backfilling and/or re-surfacing by *Giles'* client or the property owner may be required.

FIELD SAMPLING AND TESTING PROCEDURES

Auger Sampling (AU)

Soil samples are removed from the auger flights as an auger is withdrawn above the ground surface. Such samples are used to determine general soil types and identify approximate soil stratifications. Auger samples are highly disturbed and are therefore not typically used for geotechnical strength testing.

Split-Barrel Sampling (SS) – (ASTM D-1586)

A split-barrel sampler with a 2-inch outside diameter is driven into the subsoil with a 140-pound hammer free-falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the "Standard Penetration Resistance" or N-value is an index of the relative density of granular soils and the comparative consistency of cohesive soils. A soil sample is collected from each SPT interval.

Shelby Tube Sampling (ST) – (ASTM D-1587)

A relatively undisturbed soil sample is collected by hydraulically advancing a thin-walled Shelby Tube sampler into a soil mass. Shelby Tubes have a sharp cutting edge and are commonly 2 to 5 inches in diameter.

Bulk Sample (BS)

A relatively large volume of soils is collected with a shovel or other manually-operated tool. The sample is typically transported to *Giles'* materials laboratory in a sealed bag or bucket.

Dynamic Cone Penetration Test (DC) – (ASTM STP 399)

This test is conducted by driving a 1.5-inch-diameter cone into the subsoil using a 15-pound steel ring (hammer), free-falling a vertical distance of 20 inches. The number of hammer-blows required to drive the cone 1¾ inches is an indication of the soil strength and density, and is defined as "N". The Dynamic Cone Penetration test is commonly conducted in hand auger borings, test pits and within excavated trenches.

- Continued -

Ring-Lined Barrel Sampling – (ASTM D 3550)

In this procedure, a ring-lined barrel sampler is used to collect soil samples for classification and laboratory testing. This method provides samples that fit directly into laboratory test instruments without additional handling/disturbance.

Sampling and Testing Procedures

The field testing and sampling operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the field testing (i.e. N-values) are reported on the Test Boring Logs. Explanations of the terms and symbols shown on the logs are provided on the appendix enclosure entitled "General Notes".

APPENDIX C

LABORATORY TESTING AND CLASSIFICATION

The laboratory testing was conducted under the supervision of a geotechnical engineer in accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Brief descriptions of laboratory tests commonly performed by *Giles* are provided herein.

LABORATORY TESTING AND CLASSIFICATION

Photoionization Detector (PID)

In this procedure, soil samples are "scanned" in *Giles'* analytical laboratory using a Photoionization Detector (PID). The instrument is equipped with an 11.7 eV lamp calibrated to a Benzene Standard and is capable of detecting a minute concentration of **certain** Volatile Organic Compound (VOC) vapors, such as those commonly associated with petroleum products and some solvents. Results of the PID analysis are expressed in HNu (manufacturer's) units rather than actual concentration.

Moisture Content (w) (ASTM D 2216)

Moisture content is defined as the ratio of the weight of water contained within a soil sample to the weight of the dry solids within the sample. Moisture content is expressed as a percentage.

Unconfined Compressive Strength (qu) (ASTM D 2166)

An axial load is applied at a uniform rate to a cylindrical soil sample. The unconfined compressive strength is the maximum stress obtained or the stress when 15% axial strain is reached, whichever occurs first.

Calibrated Penetrometer Resistance (qp)

The small, cylindrical tip of a hand-held penetrometer is pressed into a soil sample to a prescribed depth to measure the soils capacity to resist penetration. This test is used to evaluate unconfined compressive strength.

Vane-Shear Strength (qs)

The blades of a vane are inserted into the flat surface of a soil sample and the vane is rotated until failure occurs. The maximum shear resistance measured immediately prior to failure is taken as the vane-shear strength.

Loss-on-Ignition (ASTM D 2974; Method C)

The Loss-on-Ignition (L.O.I.) test is used to determine the organic content of a soil sample. The procedure is conducted by heating a dry soil sample to 440°C in order to burn-off or "ash" organic matter present within the sample. The L.O.I. value is the ratio of the weight loss due to ignition compared to the initial weight of the dry sample. L.O.I. is expressed as a percentage.

Particle Size Distribution (ASTB D 421, D 422, and D 1140)

This test is performed to determine the distribution of specific particle sizes (diameters) within a soil sample. The distribution of coarse-grained soil particles (sand and gravel) is determined from a "sieve analysis," which is conducted by passing the sample through a series of nested sieves. The distribution of fine-grained soil particles (silt and clay) is determined from a "hydrometer analysis" which is based on the sedimentation of particles suspended in water.

Consolidation Test (ASTM D 2435)

In this procedure, a series of cumulative vertical loads are applied to a small, laterally confined soil sample. During each load increment, vertical compression (consolidation) of the sample is measured over a period of time. Results of this test are used to estimate settlement and time rate of settlement.

Classification of Samples

Each soil sample was visually-manually classified, based on texture and plasticity, in general accordance with the Unified Soil Classification System (ASTM D-2488-75). The classifications are reported on the Test Boring Logs.

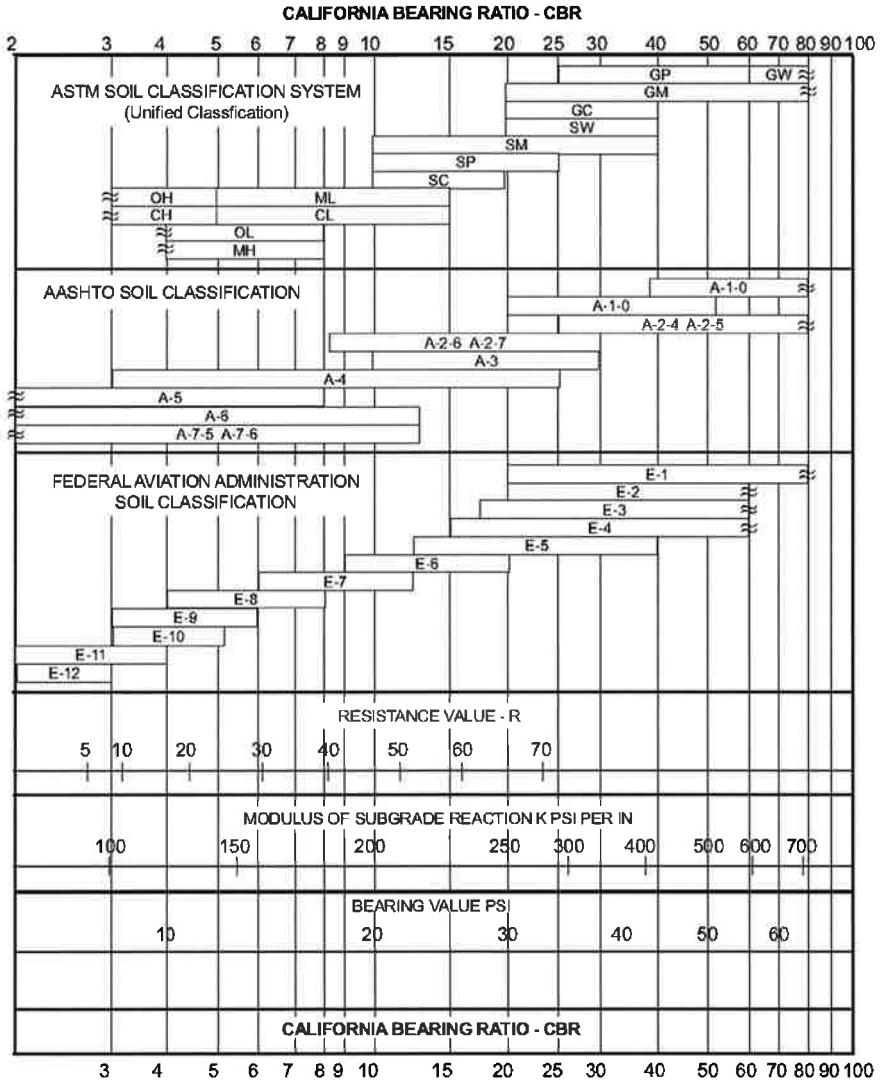
Laboratory Testing

The laboratory testing operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the laboratory tests are provided on the Test Boring Logs or other appendix enclosures. Explanation of the terms and symbols used on the logs is provided on the appendix enclosure entitled "General Notes."

California Bearing Ratio (CBR) Test ASTM D-1833

The CBR test is used for evaluation of a soil subgrade for pavement design. The test consists of measuring the force required for a 3-square-inch cylindrical piston to penetrate 0.1 or 0.2 inch into a compacted soil sample. The result is expressed as a percent of force required to penetrate a standard compacted crushed stone.

Unless a CBR test has been specifically requested by the client, the CBR is estimated from published charts, based on soil classification and strength characteristics. A typical correlation chart is below.



APPENDIX D

GENERAL INFORMATION

GUIDE SPECIFICATIONS FOR SUBGRADE AND GRADE PREPARATION FOR FILL, FOUNDATION, FLOOR SLAB AND PAVEMENT SUPPORT; AND SELECTION, PLACEMENT AND COMPACTION OF FILL SOILS USING STANDARD PROCTOR PROCEDURES

1. Construction monitoring and testing of subgrades and grades for fill, foundation, floor slab and pavement; and fill selection, placement and compaction shall be performed by an experienced soils engineer and/or his representatives.

2. All compaction fill, subgrades and grades shall be (a) underlain by suitable bearing material; (b) free of all organic, frozen, or other deleterious material, and (c) observed, tested and approved by qualified engineering personnel representing an experienced soils engineer. Preparation of subgrades after stripping vegetation, organic or other unsuitable materials shall consist of (a) proof-rolling to detect soil, wet yielding soils or other unstable materials that must be undercut, (b) scarifying top 6 to 8 inches, (c) moisture conditioning the soils as required, and (d) recompaction to same minimum in-situ density required for similar materials indicated under Item 5. Note: compaction requirements for pavement subgrade are higher than other areas. Weather and construction equipment may damage compacted fill surface and reworking and retesting may be necessary to assure proper performance.

3. In overexcavation and fill areas, the compacted fill must extend (a) a minimum 1 foot lateral distance beyond the exterior edge of the foundation at bearing grade or pavement subgrade and down to compacted fill subgrade on a maximum 0.5(H):1(V) slope, (b) 1 foot above footing grade outside the building, and (c) to floor subgrade inside the building. Fill shall be placed and compacted on a 5(H):1(V) slope or must be stepped or benched as required to flatten if not specifically approved by qualified personnel under the direction of an experienced soil engineer.

4. The compacted fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as "contaminated", and shall be low-expansive with a maximum Liquid Limit (ASTM D-423) and Plasticity Index (ASTM D-424) of 30 and 15, respectively, unless specifically tested and found to have low expansive properties and approved by an experienced soils engineer. The top 12 inches of compacted fill should have a maximum 3-inch-particle diameter and all underlying compacted fill a maximum 6-inch-diameter unless specifically approved by an experienced soils engineer. All fill materials must be tested and approved under the direction of an experienced soils engineer prior to placement. If the fill is to provide non-frost susceptible characteristics, it must be classified as a clean GW, GP, SW or SP per the Unified Soil Classification System (ASTM D-2487).

5. For structural fill depths less than 20 feet, the density of the structural compacted fill and scarified subgrade and grades shall not be less than 95 percent of the maximum dry density as determined by Standard Proctor (ASTM-698) with the exception of the top 12 inches of pavement subgrade which shall have a minimum in-situ density of 100 percent of maximum dry density, or 5 percent higher than underlying fill materials. Where the structural fill depth is greater than 20 feet, the portions below 20 feet should have a minimum in-place density of 100 percent of its maximum dry density of 5 percent greater than the top 20 feet. The moisture content of cohesive soil shall not vary by more than -1 to +3 percent and granular soil ±3 percent of the optimum when placed and compacted or recompacted, unless specifically recommended/approved by the soils engineer monitoring the placement and compaction. Cohesive soils with moderate to high expansion potentials (PI>15) should, however, be placed, compacted and maintained prior to construction at a moisture content 3±1 percent above optimum moisture content to limit further heave. The fill shall be placed in layers with a maximum loose thickness of 8 inches for foundations and 10 inches for floor slabs and pavement, unless specifically approved by the soils engineer taking into consideration the type of materials and compaction equipment being used. The compaction equipment should consist of suitable mechanical equipment specifically designed for soil compaction. Bulldozers or similar tracked vehicles are typically not suitable for compaction.

6. Excavation, filling, subgrade and grade preparation shall be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs and seepage water encountered shall be pumped or drained to provide a suitable working platform. Springs or water seepage encountered during grading/foundation construction must be called to the soil engineer's attention immediately for possible construction procedure revision or inclusion of an underdrain system.

7. Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below-grade walls (i.e. basement walls and retaining walls) must be properly tested and approved by an experienced soils engineer with consideration for the lateral pressure used in the wall design.

8. Whenever, in the opinion of the soils engineer or the Owner's Representatives, an unstable condition is being created either by cutting or filling, the work shall not proceed into that area until an appropriate geotechnical exploration and analysis has been performed and the grading plan revised, if found necessary.

GENERAL COMMENTS

The soil samples obtained during the subsurface exploration will be retained for a period of thirty days. If no instructions are received, they will be disposed of at that time.

This report has been prepared exclusively for the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. Copies of this report may be provided to contractor(s), with contract documents, to disclose information relative to this project. The report, however, has not been prepared to serve as the plans and specifications for actual construction without the appropriate interpretation by the project architect, structural engineer, and/or civil engineer. Reproduction and distribution of this report must be authorized by the client and *Giles*.

This report has been based on assumed conditions/characteristics of the proposed development where specific information was not available. It is recommended that the architect, civil engineer and structural engineer along with any other design professionals involved in this project carefully review these assumptions to ensure they are consistent with the actual planned development. When discrepancies exist, they should be brought to our attention to ensure they do not affect the conclusions and recommendations provided herein. The project plans and specifications may also be submitted to *Giles* for review to ensure that the geotechnical related conclusions and recommendations provided herein have been correctly interpreted.

The analysis of this site was based on a subsoil profile interpolated from a limited subsurface exploration. If the actual conditions encountered during construction vary from those indicated by the borings, *Giles* must be contacted immediately to determine if the conditions alter the recommendations contained herein.

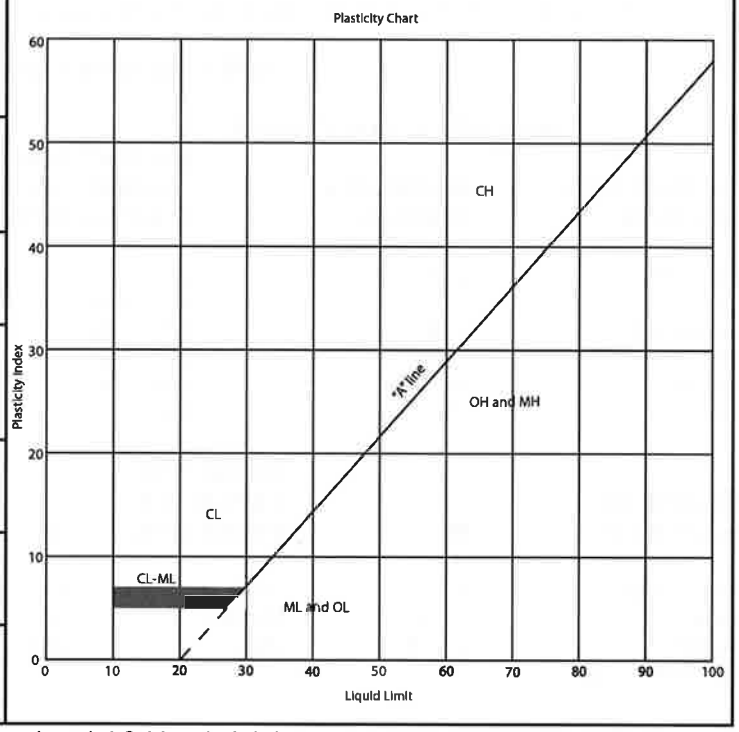
The conclusions and recommendations presented in this report have been promulgated in accordance with generally accepted professional engineering practices in the field of geotechnical engineering. No other warranty is either expressed or implied.

CHARACTERISTICS AND RATINGS OF UNIFIED SOIL SYSTEM CLASSES FOR SOIL CONSTRUCTION *									
Class	**Compaction Characteristics**	**Max. Dry Density Standard Proctor (pcf)**	**Compressibility and Expansion**	**Drainage and Permeability**	**Value as an Embankment Material**	**Value as Subgrade When Not Subject to Frost**	**Value as Base Course**	**Value as Temporary Pavement**	
								With Dust Palliative	**With Bituminous Treatment**
GW	Good: tractor, rubber-tired, steel wheel or vibratory roller	125-135	Almost none	Good drainage, pervious	Very stable	Excellent	Good	Fair to poor	Excellent
GP	Good: tractor, rubber-tired, steel wheel or vibratory roller	115-125	Almost none	Good drainage, pervious	Reasonably stable	Excellent to good	Poor to fair	Poor	
GM	Good: rubber-tired or light sheepsfoot roller	120-135	Slight	Poor drainage, semipervious	Reasonably stable	Excellent to good	Fair to poor	Poor	Poor to fair
GC	Good to fair: rubber-tired or sheepsfoot roller	115-130	Slight	Poor drainage, impervious	Reasonably stable	Good	Good to fair **	Excellent	Excellent
SW	Good: tractor, rubber-tired or vibratory roller	110-130	Almost none	Good drainage, pervious	Very stable	Good	Fair to poor	Fair to poor	Good
SP	Good: tractor, rubber-tired or vibratory roller	100-120	Almost none	Good drainage, pervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SM	Good: rubber-tired or sheepsfoot roller	110-125	Slight	Poor drainage, impervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SC	Good to fair: rubber-tired or sheepsfoot roller	105-125	Slight to medium	Poor drainage, impervious	Reasonably stable	Good to fair	Fair to poor	Excellent	Excellent
ML	Good to poor: rubber-tired or sheepsfoot roller	95-120	Slight to medium	Poor drainage, impervious	Poor stability, high density required	Fair to poor	Not suitable	Poor	Poor
CL	Good to fair: sheepsfoot or rubber-tired roller	95-120	Medium	No drainage, impervious	Good stability	Fair to poor	Not suitable	Poor	Poor
OL	Fair to poor: sheepsfoot or rubber-tired roller	80-100	Medium to high	Poor drainage, impervious	Unstable, should not be used	Poor	Not suitable	Not suitable	Not suitable
MH	Fair to poor: sheepsfoot or rubber-tired roller	70-95	High	Poor drainage, impervious	Poor stability, should not be used	Poor	Not suitable	Very poor	Not suitable
CH	Fair to poor: sheepsfoot roller	80-105	Very high	No drainage, impervious	Fair stability, may soften on expansion	Poor to very poor	Not suitable	Very poor	Not suitable
OH	Fair to poor: sheepsfoot roller	65-100	High	No drainage, impervious	Unstable, should not be used	Very poor	Not suitable	Not suitable	Not suitable
Pt	Not suitable		Very high	Fair to poor drainage	Should not be used	Not suitable	Not suitable	Not suitable	Not suitable

* "The Unified Classification: Appendix A - Characteristics of Soil, Groups Pertaining to Roads and Airfields, and Appendix B - Characteristics of Soil Groups Pertaining to Embankments and Foundations," Technical Memorandum 357, U.S. Waterways Experiment Station, Vicksburg, 1953.

** Not suitable if subject to frost.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria	
Coarse-grained soils (more than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent: GW, GP, SW, SP; More than 12 percent: GM, GC, SM, SC; 5 to 12 percent: *Borderline* cases requiring dual symbols[b]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP		Poorly graded gravels, gravel-sand mixtrues, little or no fines		Not meeting all gradation requirements for GW
		Gravels with fines (appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4 — Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u			Atterberg limits above "A" line or P.I. greater than 7
			GC		Clayey gravels, gravel-sand-clay mixtures		
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4 — Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u			Atterberg limits above "A" line or P.I. greater than 7
			SC		Clayey sands, sand-clay mixtures		
Fine-grained soils (More than half material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays		
			OL		Organic silts and organic silty clays of low plasticity		
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH		Inorganic clays of high plasticity, fat clays		
			OH		Organic clays of medium to high plasticity, organic silts		
	Highly organic soils		Pt		Peat and other highly organic soils		

[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits, suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u is used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group sympols. For example GW-GC, well-graded gravel-sand mixture with clay binder.

Giles Engineering Associates, Inc.

GENERAL NOTES

SAMPLE IDENTIFICATION

All samples are visually classified in general accordance with the Unified Soil Classification System (ASTM D-2487-75 or D-2488-75)

DESCRIPTIVE TERM (% BY DRY WEIGHT)

Trace:	1-10%
Little:	11-20%
Some:	21-35%
And/Adjective	36-50%

PARTICLE SIZE (DIAMETER)

Boulders:	8 inch and larger
Cobbles:	3 inch to 8 inch
Gravel:	coarse - ¾ to 3 inch
	fine – No. 4 (4.76 mm) to ¾ inch
Sand:	coarse – No. 4 (4.76 mm) to No. 10 (2.0 mm)
	medium – No. 10 (2.0 mm) to No. 40 (0.42 mm)
	fine – No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt:	No. 200 (0.074 mm) and smaller (non-plastic)
Clay:	No 200 (0.074 mm) and smaller (plastic)

SOIL PROPERTY SYMBOLS

Dd:	Dry Density (pcf)
LL:	Liquid Limit, percent
PL:	Plastic Limit, percent
PI:	Plasticity Index (LL-PL)
LOI:	Loss on Ignition, percent
Gs:	Specific Gravity
K:	Coefficient of Permeability
w:	Moisture content, percent
qp:	Calibrated Penetrometer Resistance, tsf
qs:	Vane-Shear Strength, tsf
qu:	Unconfined Compressive Strength, tsf
qc:	Static Cone Penetrometer Resistance (correlated to Unconfined Compressive Strength, tsf)
PID:	Results of vapor analysis conducted on representative samples utilizing a Photoionization Detector calibrated to a benzene standard. Results expressed in HNU-Units. (BDL=Below Detection Limit)

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon
ST:	Shelby Tube – 3 inch O.D. (except where noted)
CS:	3 inch O.D. California Ring Sampler
DC:	Dynamic Cone Penetrometer per ASTM Special Technical Publication No. 399
AU:	Auger Sample
DB:	Diamond Bit
CB:	Carbide Bit
WS:	Wash Sample
RB:	Rock-Roller Bit
BS:	Bulk Sample
Note:	Depth intervals for sampling shown on Record of Subsurface Exploration are not indicative of sample recovery, but position where sampling initiated

N: Penetration Resistance per 12 inch interval, or fraction thereof, for a standard 2 inch O.D. (1⅜ inch I.D.) split spoon sampler driven with a 140 pound weight free-falling 30 inches. Performed in general accordance with Standard Penetration Test Specifications (ASTM D-1586). N in blows per foot equals sum of N-Values where plus sign (+) is shown.

Nc: Penetration Resistance per 1¾ inches of Dynamic Cone Penetrometer. Approximately equivalent to Standard Penetration Test N-Value in blows per foot.

Nr: Penetration Resistance per 12 inch interval, or fraction thereof, for California Ring Sampler driven with a 140 pound weight free-falling 30 inches per ASTM D-3550. Not equivalent to Standard Penetration Test N-Value.

SOIL STRENGTH CHARACTERISTICS

COHESIVE (CLAYEY) SOILS

COMPARATIVE CONSISTENCY	BLOWS PER FOOT (N)	UNCONFINED COMPRESSIVE STRENGTH (TSF)
Very Soft	0 - 2	0 - 0.25
Soft	3 - 4	0.25 - 0.50
Medium Stiff	5 – 8	0.50 - 1.00
Stiff	9 – 15	1.00 - 2.00
Very Stiff	16 – 30	2.00 - 4.00
Hard	31+	4.00+

NON-COHESIVE (GRANULAR) SOILS

RELATIVE DENSITY	BLOWS PER FOOT (N)
Very Loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	51+

DEGREE OF PLASTICITY	PI	DEGREE OF EXPANSIVE POTENTIAL	PI
None to Slight	0 - 4	Low	0 - 15
Slight	5 - 10	Medium	15 - 25
Medium	11 - 30	High	25+
High to Very High	31+		

Important Information About Your Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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PROJECT MANUAL
FOR THE CONSTRUCTION OF

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS

SOUTH MILWAUKEE, WISCONSIN

VOLUME 3

APRIL 2018

Applied Technologies
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CITY OF SOUTH MILWAUKEE

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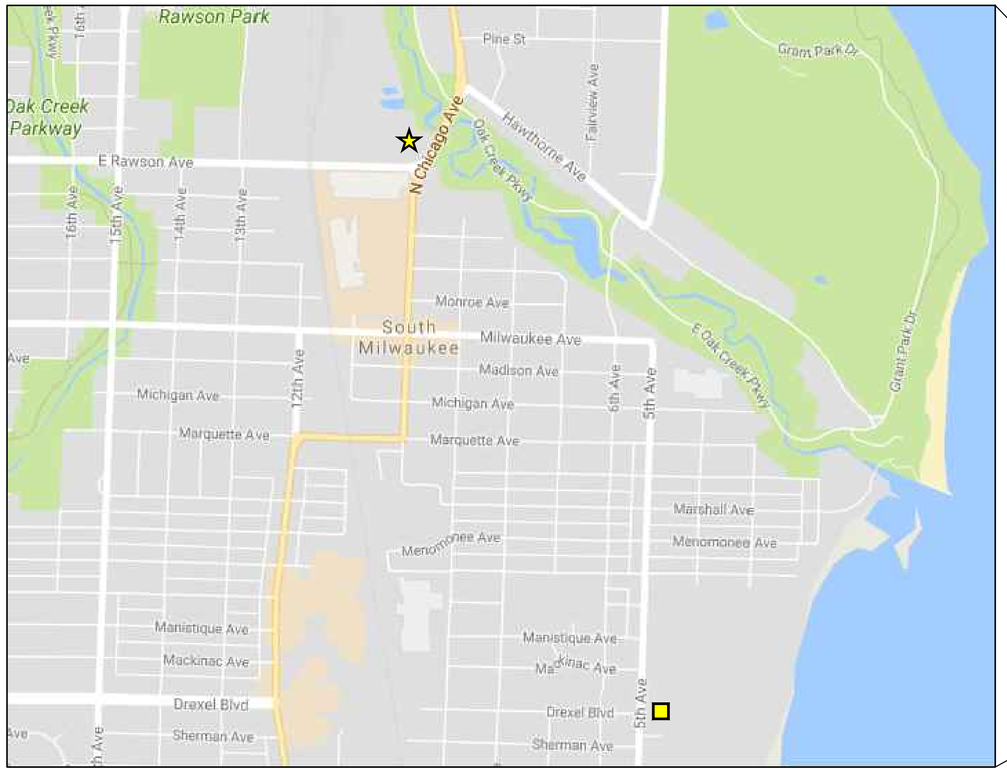
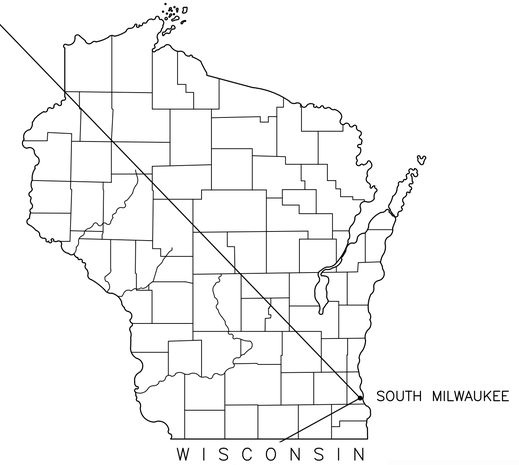


PROJECT LOCATION

CONSTRUCTION STORAGE LOCATION

LOCATION MAP



WISCONSIN
KATHLEEN R. HASSING
42127
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PROFESSIONAL ENGINEER

DRAWING NUMBER DESIGNATION

20-G-1

- 20 — INDICATES FACILITY NUMBER SEE LOCATION PLAN, DWG 20-G-1
- G-1 — INDICATES DRAWING NUMBER
- G — INDICATES DISCIPLINE:
  - A ARCHITECTURAL
  - C CIVIL
  - E ELECTRICAL
  - G GENERAL
  - H HVAC
  - I I & C
  - M MECHANICAL
  - P PLUMBING
  - R REMOVAL
  - S STRUCTURAL

40-SM-2

- SM — DUAL LETTERS INDICATE COMBINED DISCIPLINES

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NORTH CHICAGO LIFT STATION IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

PROJECT REFERENCE
GENERAL
TITLE SHEET

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 10-G-1

PSLTSCALE: 1 LTSCALE: 1
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10-M-1	MECHANICAL	LEGEND
10-E-1	ELECTRICAL	LEGEND
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ABBREVIATIONS

@	AT
AAD	AUTOMATIC CONTROL AIR DAMPER
A/B	AERATION BASIN
AB	ANCHOR BOLT
ABV	ABOVE
ABDN	ABANDONED
ACA	AT CEILING ABOVE
ACBD	ACOUSTICAL BOARD
ACC	AIR COOLED COMPRESSOR/CONDENSING UNIT
ACST	ACOUSTICAL TILE
ACT	ACOUSTICAL
AD	AREA DRAIN
ADDL	ADDITIONAL
ADJ	ADJACENT
AFF	ABOVE FINISHED FLOOR
AHR	ANCHOR
AL	ALUMINUM
ALTN	ALTERNATE
ANOD	ANODIZED
APPROX	APPROXIMATE
APVD	APPROVED
ARCH	ARCHITECTURAL
AS	AIR SCRUBBER
ASPH	ASPHALT
ASSY	ASSEMBLY
ASU	CENTRAL STATION AIR HANDLING UNIT
AVG	AVERAGE
B	BOILER
BC	BOOSTER COIL
BD	BOARD
BEL	BELOW
BETW	BETWEEN
BF	BOTTOM FACE
BLDG	BUILDING
BLK	BLOCK
BM	BEAM
B.O.	BOTTOM OF
BOD	BOTTOM OF DUCT
BOD 5	BIOCHEMICAL OXYGEN DEMAND (5 DAY TEST)
BOP	BOTTOM OF PIPE
BOT/BTM	BOTTOM
BRG	BEARING
CAB	CABINET
CAF	CABINET FAN
CARP	CARPET
CB	CATCH BASIN
CC	COOLING COIL
C/C	CHLORINE CONTACT
CEF	CEILING EXHAUST FAN
CEM PLAS	CEMENT PLASTER
CF	CENTRIFUGAL FAN
CFM	CUBIC FEET PER MINUTE
CG	CORNER GUARD
CH	COAT HOOK
CHEM	CHEMICAL
CHKD	CHECKERED
CJ	CONSTRUCTION JOINT
C/L	CENTER LINE
CI	CAST IRON
CL	CLOSET
CL 2	CHLORINE
CLG	CEILING
CLP	CLAY PIPE
CLR	CLEAR
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNITS
CO	CLEANOUT
COD	CHEMICAL OXYGEN DEMAND
COL	COLUMN
COMM	COMMUNICATION
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS, CONTINUED
CJ	CONTROL JOINT
CONTR	CONTRACTOR
COR	CORNER
CP	CONCRETE PIPE
CPLG	COUPLING
CT	CERAMIC TILE
CPVC	CHLORINATED POLYVINYL CHLORIDE
CRS	COURSES
C TO C	CENTER TO CENTER
CTR	CENTER
CTRD	CENTERED
CU FT	CUBIC FEET
CUH	CABINET UNIT HEATER
CW	COLD WATER
△	CENTRAL ANGLE

D	DRAIN
DBA	DEFORMED BAR ANCHOR
DBL	DOUBLE
DECHLOR	DECHLORINATION
DET	DETAIL
DF	DRINKING FOUNTAIN
DH	DEHUMIDIFIER
DI	DUCTILE IRON
DIA	DIAMETER
DIAG	DIAGONAL
DIM	DIMENSION
DIP	DUCTILE IRON PIPE
DIR	DIRECTION
DRWR	DRAWER
DN	DOWN
DISCH	DISCHARGE
DS	DOWNSPOUT
DWG	DRAWING
DWL	DOWEL
E	EAST
E	EXTERNAL
EA	EACH
EB	EXPANSION BOLT
ECC	ECCENTRIC
EDH	ELECTRIC DUCT HEATER
EE	EMERGENCY EYE WASH
EF	EACH FACE
EFL	EFFLUENT
EHD	ELECTRIC HAIR DRYER
EL	ELEVATION
ELB	ELBOW
ELEC	ELECTRICAL
ELEV	ELEVATOR
EQL	EQUAL
EQL SP	EQUALLY SPACED
EQPT	EQUIPMENT
EUH	ELECTRIC UNIT HEATER
EW	EACH WAY
EWC	ELECTRIC WATER COOLER
EXF	EXHAUST FAN
EJ	EXPANSION JOINT
EXT	EXTERIOR
EXST	EXISTING
FAB	FABRICATION
FACIL	FACILITY
FB	FLAT BAR
FCO	FLOOR CLEANOUT
FCTY, FACT	FACTORY
FD	FLOOR DRAIN
FDN	FOUNDATION
F. EXT	FIRE EXTINGUISHER
FFA	FROM FLOOR ABOVE
FFB	FROM FLOOR BELOW
F FL	FINISHED FLOOR
FLL	FLOW LINE ELEVATION
FLEX	FLEXIBLE
FLG	FLANGE
FLR	FLOOR
FM	FORCE MAIN
FNSH	FINISH
FNSH GD	FINISHED GRADE
FNV	FOLDED NAPKIN VENDOR
FO	FIBER OPTIC
FP	FIN TUBE CONVECTOR
FR	FIRE RATED
FRP	FIBERGLASS REINFORCED PLASTIC
FT	FOOT
FTG	FOOTING
FVNR	FULL VOLTAGE NON-REVERSING
FVR	FULL VOLTAGE REVERSING
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GALVS	GALVANIZED STEEL
GB	GRAB BAR
GPD	GALLONS PER DAY
GWB	GYPSUM WALLBOARD
GYP PLAS	GYPSUM PLASTER

H.A.S	HEADED ANCHOR STUD
HC	HEATING COIL
HCR	HAT & COAT RACK
HD	HUB DRAIN
HDNR	HARDENER
HDR	HEADER
HDW	HARDWARE
HGT	HEIGHT
HM	HOLLOW METAL
HORIZ	HORIZONTAL
HPRV	HYDROSTATIC PRESSURE RELIEF VALVE
HR	HOUR
HVAC	HEATING, VENTILATING, & AIR CONDITIONING
HW	HOT WATER
HWP	HOT WATER PUMP
HWRP	HOT WATER RADIANT PANEL
HX	HEAT EXCHANGER
HYD	HYDRANT
I&C	INSTRUMENTATION AND CONTROL
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IF	INSIDE FACE
IG	INSULATING GLASS
INFL	INFLUENT
INSTL	INSTALL
INSUL	INSULATION
INT	INTERIOR
INTMD	INTERMEDIATE
INV	INVERT
ITG	INSULATED TEMPERED GLASS
JAN	JANITOR
JT	JOINT
KVA	KILOVOLT-AMPERE
KSK	KITCHEN SINK
L	LENGTH OF CURVE
L	ANGLE
LAV	LAVATORY
LB	POUNDS
LB/D	POUNDS PER DAY
LCP	LOCAL CONTROL PANEL
LCUS	LOAD CENTER UNIT SUBSTATION
LF	LINEAL FEET
LG	LONG
LIW	LOAD INDICATING WASHERS
LL	LIVE LOAD
LLV	LONG LEG VERTICAL
LNTL	LINTEL
LONG	LONGITUDINAL
LOS	LOCKOUT STOP PUSHBUTTON
LR	LONG RADIUS
LT	LIGHT
LV	LABORATORY VACUUM
LV	LOW VOLTAGE
LW	LONG WAY
M-X	MIRROR
MATL	MATERIAL
MAX	MAXIMUM
MB	MACHINE BOLT
MBH	THOUSAND BTU PER HOUR
MCC	MOTOR CONTROL CENTER
MD	MOTORIZED DAMPER
MECH	MECHANICAL
MFR	MANUFACTURER
MGD	MILLION GALLONS PER DAY
MG/L	MILLIGRAMS PER LITRE
MH	MANHOLE
MH	MOP HOLDER
MIN	MINIMUM
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MLSS	MIXED LIQUOR SUSPENDED SOLIDS
MLVSS	MIXED LIQUOR VOLATILE SUSPENDED SOLIDS
MO	MONTH
MO	MASONRY OPENING
MON	MONUMENT
MTG	MOUNTING
MTL	METAL
MTRG	METERING
N	NORTH
NIC	NOT IN CONTRACT
NO.	NUMBER
NOM	NOMINAL
NORM	NORMAL
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER, OVERFLOW DRAIN
OF	OUTSIDE FACE
O/H	OVERHEAD
OPNG	OPENING
OPP	OPPOSITE
O TO O	OUT TO OUT
OZ.	OUNCE

P&ID	PROCESS AND INSTRUMENTATION DIAGRAM
PBX	PULL BOX
PC	POINT OF CURVATURE
P/C	PRIMARY CLARIFIERS
PE	PLAIN END
PF	PROPELLER FAN
PH	PHASE
PI	POINT OF INTERSECTION
PJF	PREMOLDED JOINT FILLER
P/L	PROPERTY LINE
PL	PLATE
PLAM	PLASTIC LAMINATE
PLAS	PLASTER
PLYWD	PLYWOOD
POC	POINT ON CURVE
POT	POINT ON TANGENT
PR	PAIR
PRCST	PRECAST
PROJ	PROJECTION
PS	PUMP STATION
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PTD	PAPER TOWEL DISPENSER
PTD/R	PAPER TOWEL DISPENSER/RECPTACLE
PVC	POINT OF VERTICAL CURVATURE
PVC	POLYVINYL CHLORIDE
PVI	POINT OF VERTICAL INTERSECTION
PVMT	PAVEMENT
PVT	POINT OF VERTICAL TANGENCY
PWS	PLASTIC WATER STOP
QDRNT	QUADRANT
QT	QUARRY TILE
R	R-VALUE (INSULATION)
R OR RAD	RADIUS
R	RISER
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RD	ROOF DRAIN
RDCR	REDUCER
REC	RECESSED EXTINGUISHER CABINET
REFR	REFRIGERATOR
REHAB	REHABILITATION
REINF	REINFORCE
REQD	REQUIRED
RESIL	RESILIENT
RF	RETURN FAN
RH	ROBE HOOK
RM	ROOM
RO	ROUGH OPENING
RR	RAILROAD
RS	ROOF SUPPLY
RST	REINFORCING STEEL
S	SOUTH
SAN	SANITARY SEWER
SAT	SUSPENDED ACOUSTICAL TILE
SC	SHOWER CURTAIN
S/C	SECONDARY CLARIFIERS
SCHED	SCHEDULE
SCR	SHOWER CURTAIN ROD
SD	SOAP DISPENSER
SDS	SELF DRILLING SCREW
SD/GB	SOAP DISH & GRAB BAR
SEAL	SEALER
SECT	SECTION
SF	SUPPLY FAN
SG	SAFETY GLASS
SH	SHEET
SH	SHOWER
SHS	FOLD-UP SHOWER SEAT
SHTG	SHEETING
SIM	SIMILAR
SK	SINK
SLV	SHORT LEG VERTICAL
SND	SANITARY NAPKIN DISPENSER1
S.O.	SHUTOFF
SPECD	SPECIFIED
SPECS	SPECIFICATIONS
SPG	SPACING
SQ	SQUARE
SQF	SEAMLESS QUARTZ FLOORING
SS	SUBSTATION
SSH	SAFETY SHOWER
SSK	SERVICE SINK
SST	STAINLESS STEEL
STA	STATION
STD	STANDARD
STIF	STIFFENER
ST	STORM SEWER
STOR	STORAGE
STR	STRAIGHT
STRUCT	STRUCTURAL
STL	STEEL
SUSP	SUSPENDED
SW	SHORT WAY
SWD	SIDE WATER DEPTH
SYMM	SYMMETRICAL

T	TANGENT LENGTH
T	TINTED
T	TREAD
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TC	TOP OF CONCRETE
TD	TOWEL DISPENSER
TD	TRENCH DRAIN
TEL	TELEPHONE
TEMP	TEMPORARY
TF	TOP FACE
TFA	TO FLOOR ABOVE
TFB	TO FLOOR BELOW
TG	TEMPERED GLASS
THK	THICK
THRD	THREADED
T.O.	TOP OF
TP	TOWEL PIN
TPD	TONS PER DAY
TPI	TURNOUT POINT OF INTERSECTION
TRANSV	TRANSVERSE
TSS	TOTAL SUSPENDED SOLIDS
TST	TOP OF STEEL
TTC	TELEPHONE TERMINAL CABINET
TT	TOILET TISSUE DISPENSER
TW	TOP OF WALL
TYP	TYPICAL
UF	UTILITY FAN
UG	UNDERGROUND
UHE	ELECTRIC UNIT HEATER
UHG	GAS UNIT HEATER
UHW	HOT WATER UNIT HEATER
UPS	UNINTERRUPTIBLE POWER SUPPLY
UR	URINAL
V	VENT
VB	VINYL BASE
VCP	VITRIFIED CLAY PIPE
VCT	VINYL COMPOSITION TILE
VD	MANUAL AIR VOLUME DAMPER
VE	VEHICLE EXHAUST SYSTEM
VERT	VERTICAL
VP	VAPOR PROOF
VTR	VENT THRU ROOF
VWC	VINYL WALL COVERING
W	WEST
W/	WITH
WAT	WATER MAIN
WC	WATER CLOSET
WD	WOOD
WE	WALL EXHAUSTER
WG	WIRE GLASS
WH	WATER HEATER
WK	WEEK
WP	WORKING POINT
WR	WASTE RECEPTACLE
WR GWB	WATER RESISTANT GYPSUM WALLBOARD
WS	WASH STATION
WS	WATER STOP OR WATERSURFACE
WS	WELDED STEEL
WWF	WELDED WIRE FABRIC
XFMR	TRANSFORMER
YR	YEAR

DETAIL LEGEND

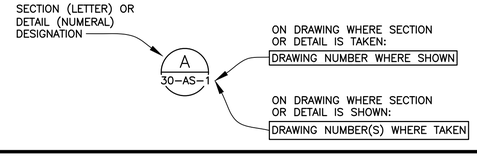
STANDARD DETAIL DESIGNATION

* (13280) STANDARD DETAIL NUMBER

02000-02999	CIVIL/SITEWORK DETAILS
03000-05999	ARCHITECTURAL/STRUCTURAL DETAILS
04000-04999	ARCHITECTURAL/STRUCTURAL DETAILS
05000-05999	ARCHITECTURAL/STRUCTURAL DETAILS
06000-10999	ARCHITECTURAL/STRUCTURAL DETAILS
13000-13999	I & C DETAILS
15000-15999	MECHANICAL DETAILS
16000-16999	ELECTRICAL DETAILS

* NOTE:
ALL STANDARD DETAILS APPLY TO THE ENTIRE PROJECT WHETHER SPECIFICALLY CALLED OUT OR NOT.

DETAIL AND SECTION DESIGNATION



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Applied Technologies
Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

PROJECT REFERENCE
GENERAL
LEGEND

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: .
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 10-G-3

PSLTSCALE: 1 LTSCALE: 1
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STANDARD SITEWORK LEGEND & SYMBOLS

NOTE:
THIS IS A STANDARD LEGEND AND NOT ALL OF THE INFORMATION SHOWN MAY BE USED ON THIS PROJECT.

EXISTING	DESCRIPTION	PROPOSED
	BENCHMARK	
	MONUMENT	
R/W	RIGHT OF WAY MARKER	
	IRON PIPE (PROPERTY CORNER)	
	IRON ROD/SPIKE	
	CONTROL POINT	
	CHISELED CROSS	
	SPOT ELEVATION	625.35
	SOIL BORING	
	MONITORING WELL	
	LIFT STATION	
	MANHOLES	
	CLEANOUT	
	WELL	
	HYDRANT	
	VALVES (GAS/WAT)	
	CURB STOP	
	CURB INLET/BASIN	
	YARD INLET/BASIN	
	CORRUGATED METAL PIPE	
	REINFORCED CONCRETE PIPE END SECTION	
	METERS (ELEC/GAS/WATER)	
	PEDESTALS (ELEC/TEL/CTV)	
	POWERLINE TOWER	
	UTILITY POLE	RELOCATED
	GUY WIRE / DEAD MAN	
	TRAFFIC SIGNAL POLE	
	TRAFFIC SIGNAL BOX/PULL BOX	
	LIGHT POLE	
	FLOOD LIGHT/YARD LIGHT	
	DECIDUOUS TREE	REMOVED
	CONIFEROUS TREE	REMOVED
	DECIDUOUS BUSH/SHRUB	REMOVED
	CONIFEROUS BUSH/SHRUB	REMOVED
	STUMP	REMOVED
	ROCK/BOULDER	
MB	MAILBOX	
POST	GUARD METAL/WOOD POST	
	FLAG POLE	
	SIGN POST/BILLBOARD POLE	
	WATER SURF. EL.	

EXISTING	DESCRIPTION	PROPOSED
	TO BE ABANDONED	
	TO BE REMOVED	
	SECTION LINE	
R/W	RIGHT OF WAY (ROW)	
P/L	PROPERTY LINE	
	EASEMENT (PERMANENT)	
	EASEMENT (TEMPORARY)	
	ROAD CENTERLINE	5+00
100YR	100 YEAR FLOODPLAIN	
	WETLAND	
SAN	SANITARY SEWER	SAN
W	WATER MAIN	W
FM	FORCE MAIN	FM
ST	STORM SEWER	ST
G	GAS LINE	
FO	FIBER OPTIC	
OE / E / UE	ELECTRICAL	
OT / T / UT	TELEPHONE	
OC / CTV / UC	CABLE TV	
	DITCH/SWALE	
	DECIDUOUS WOODS OR BRUSH	
	EVERGREEN WOODS OR BRUSH	
	FENCE	
	ROCK WALL	
	RAILROAD	
EOW	EDGE OF LAKE, RIVER, ETC.	
TB / BB	TOP/BOTTOM OF BANK	
	CULVERT (CMP UNLESS NOTED)	
742	CONTOUR	742
HP	HIGH POINT	HP
	SAWCUT	XXXXXXXXXXXXXXXXXXXXXXXXX
	SILT FENCE	

EXISTING	DESCRIPTION	PROPOSED
GRAVEL	GRAVEL ROAD	GRAVEL
ASPH	PAVED ROADWAY	ASPH
ASPH	PAVED ROADWAY W/CURB & GUTTER	ASPH
	STRUCTURE	
CONC	PORTLAND CEMENT CONCRETE PAVEMENT	CONC
CONC	CONCRETE WALK	

LANDSCAPING LEGEND

- DECIDUOUS TREE (10" ø)
- CONIFEROUS TREE (10" ø)
- DECIDUOUS SHRUB, LARGE (6' ø)
- CONIFEROUS SHRUB, LARGE (6' ø)
- DECIDUOUS SHRUB, MEDIUM (4' ø)
- CONIFEROUS SHRUB, MEDIUM (4' ø)
- DECIDUOUS SHRUB, SMALL (2' ø)
- CONIFEROUS SHRUB, SMALL (2' ø)
- ORNAMENTAL GRASSES
- NO MOW LAWN
- PERENNIALS

SITE SURVEY BY:
EDGEWOOD SURVEYING
14195 W. BEECHWOOD TRAIL
NEW BERLIN, WI 53151
PHONE: 262-366-5749
SURVEY DATES: 6/2/16, 6/21/16, 1/16/17, 2/2/17

city of South Milwaukee — Proud Past ... Promising Future

Applied Technologies Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
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IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

PROJECT REFERENCE
CIVIL
LEGEND

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	.
DRAWN BY:	P.C.G.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	10-C-1

PSLTSCALE: 1 LTSCALE: 1
J:\5795 - S Mke\GRAPHICS\DRAWINGS\10-C-1 LEGEND.dwg Last Modified: 10 February 2017 Plotted On: 4/16/2018 2:37 PM by PHIL GERLACH
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PIPING SYMBOLS

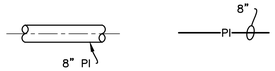
DOUBLE	SINGLE	
		EXISTING PIPE
		EXISTING PIPE TO BE ABANDONED
		EXISTING PIPE TO BE REMOVED
		NEW PIPE
		WELDED JOINT
		GROOVED END JOINT
		FLANGED JOINT
		MECHANICAL JOINT
		HUB & SPIGOT JOINT (RUBBER GASKET)
		BALL JOINT
		GROOVED END ADAPTER FLANGE
		FLANGED COUPLING ADAPTER
		FLEXIBLE COUPLING
		FLEXIBLE COUPLING WITH THRUST TIES
		STEEL BELLOWS EXP JOINT
		ELASTOMER BELLOWS EXP JOINT
		ELBOW UP
		ELBOW DOWN
		TEE UP
		TEE DOWN
		LATERAL UP
		LATERAL DOWN
		CONCENTRIC REDUCER
		ECCENTRIC REDUCER
		UNION
		CAP
		ANCHOR

DOUBLE	SINGLE	
		ELBOW, 90 DEGREE
		CROSS
		TEE
		ELBOW, 45 DEGREE
		LATERAL
		STRAINER
		SIGHT GLASS
		FLEXIBLE (ELASTOMER) PIPE CONNECTION
		HOSE VALVE (HV–X) X = NO. IN SPECS
		PIG LAUNCHER
		PIG CATCHER
		ULTRASONIC FLOWMETER (CLAMP–ON)

GENERAL PIPING NOTES

1. LAY PIPE TO UNIFORM GRADE BETWEEN INDICATED ELEVATION POINTS.
2. SIZE OF FITTINGS SHOWN ON PLANS SHALL CORRESPOND TO ADJACENT STRAIGHT RUN OF PIPE. UNLESS OTHERWISE INDICATED. TYPE OF JOINT AND FITTING MATERIAL SHALL BE THE SAME AS SHOWN FOR ADJACENT STRAIGHT RUN OF PIPE.
3. LOCATION AND NUMBER OF PIPE HANGERS AND PIPE SUPPORTS SHOWN IS ONLY APPROXIMATE. FINAL SUPPORT REQUIREMENTS SHALL BE DETERMINED IN THE FIELD BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO INSTALLATION. MAXIMUM SPACING SHALL BE AS SPECIFIED.
4. ALL JOINTS SHALL BE WATERTIGHT. STANDARD WALL PIPE DETAIL (15223) SHALL BE USED WHEREVER PIPING PASSES FROM A STRUCTURE TO BACKFILL. (UNLESS NOTED OTHERWISE)
5. ALL FLEXIBLE CONNECTORS OR FLANGED COUPLING ADAPTERS SHALL BE PROVIDED WITH THRUST TIES, BLOCKS, OR ANCHORS, UNLESS OTHERWISE NOTED. THRUST PROTECTION SHALL BE ADEQUATE FOR PRESSURES SPECIFIED.
6. SYMBOLS, LEGENDS, AND PIPE USE IDENTIFICATIONS SHOWN SHALL BE FOLLOWED THROUGHOUT THE PLANS, WHEREVER APPLICABLE. ALL OF THE VARIOUS PIPING APPLICATIONS ARE NOT NECESSARILY USED IN THE PROJECT.
7. ALL BURIED PIPING SPECIFIED TO BE PRESSURE TESTED. EXCEPT FLANGED, WELDED, OR SCREWED PIPING, SHALL BE PROVIDED WITH CONCRETE THRUST BLOCKS AT ALL DIRECTION CHANGES UNLESS OTHERWISE NOTED. SEE THRUST BLOCK DETAILS AND NOTES.
8. NUMBER AND LOCATION OF UNIONS SHOWN ON PLANS IS ONLY APPROXIMATE. PROVIDE ALL UNIONS NECESSARY TO FACILITATE CONVENIENT REMOVAL OF VALVES AND MECHANICAL EQUIPMENT.
9. WHERE A GROOVED END COUPLING IS SHOWN, IT SHALL BE THE RIGID JOINT TYPE, UNLESS OTHERWISE SPECIFIED. WHERE A FLANGED COUPLING ADAPTER IS SHOWN. A STANDARD FLANGE SHALL BE USED TO JOIN THE COUPLING ADAPTER.
10. ONLY FLANGED END CONNECTIONS ARE SHOWN ON THE DRAWINGS FOR DOUBLE LINE FITTINGS AND ARE GENERAL ONLY. SIMILARLY, SYMBOLS SHOWNFOR SINGLE LINE DRAWINGS ARE GENERIC ONLY. REFER TO THE PIPING SPECIFICATIONS FOR SPECIFIC END CONNECTIONS.
11. EXISTING PIPING, VALVES AND EQUIPMENT IS SHOWN LIGHTLINED AND/OR SCREENED.
12. DESIGNATIONS FOR PIPING ARE CALLED OUT WITH IDENTIFICATION FROM FLOW STREAM AND NOMINAL PIPE DIAMETER.

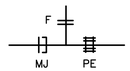
EXAMPLE:



13. PIPING END FITTINGS ARE DESIGNATED WITH THE FOLLOWING ABBREVIATIONS.

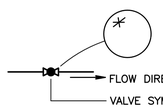
B	BELL	PE	PLAIN END
S	SPIGOT	GE	GROOVED END
F	FLANGE	MJ	MECHANICAL JOINT

EXAMPLE:



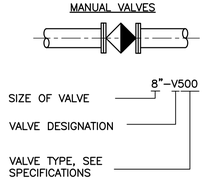
14. VALVE DESIGNATIONS FOR SIZE AND TYPE ARE SHOWN IN THE FOLLOWING EXAMPLES FOR MANUAL VALVES AND CONTROL VALVES.

CONTROL VALVES



BUBBLE WITH XV OR XCV DESIGNATION SHOWN ON P&ID WHERE: X = PROCESS VARIABLE

MANUAL VALVES



15. FOR VALVE AND GATE SYMBOLS SEE I&C LEGEND

FLOW STREAM IDENTIFICATION

LEGEND	SERVICE
AA	AQUA AMMONIA
ACL	ACETYLENE GAS
AE	AERATED EFFLUENT
AG	ARGON GAS
AHP	AIR, HIGH PRESSURE PROCESS
AI	INSTRUMENT AIR
AIR	AIR, LABORATORY
ALP	AIR, LOW PRESSURE PROCESS
ALKY	ALKALINITY
APO	ANIONIC POLYMER SOLUTION
ARD	ACID RESISTANT DRAIN
ARV	ACID RESISTANT VENT
BFE	BIOFILTER EFFLUENT
BFR	BIOFILTER RECYCLE
BSD	BIOFILTER SLUDGE
BW	BACKWASH
CG	CHLORINE GAS (PRESSURE)
CGV	CHLORINE GAS (VACUUM)
CL	CHLORINE LIQUID (PRESSURE)
COAG	COAGULANT
COD	CHEMICAL OXYGEN DEMAND
CPO	CATIONIC POLYMER SOLUTION
CS	CHLORINE SOLUTION
CSPD	CHEMICAL SUMP PUMP DISCHARGE
CSS	CHEMICAL SCRUBBING SOLUTION
D	DRAIN
DD	PROCESS DRAIN
DG	DIGESTER GAS
DIW	DEIONIZED WATER
DMW	DEMINERALIZED WATER
DP	DRY POLYMER
DSD	DIGESTED SLUDGE
DW	DISTILLED WATER
DWSD	DEWATERED SLUDGE
F	FILTRATE
FA	FLUOROSILICIC ACID
FAC	FLUOROSILICIC ACID IN CONTAINMENT
FC	FERRIC CHLORIDE
FCC	FERRIC CHLORIDE w/ CONTAINMENT
FE	FINAL EFFLUENT
FP	FIRE PROTECTION
FW	FILTERED WATER
G	NATURAL GAS
GR	GRIT SLURRY
H	HYDROGEN GAS
HCL	HYDROCHLORIC ACID
HPHW	HIGH PRESSURE HOT WATER
HPX	HYDROGEN PEROXIDE
HW	HOT WATER, DOMESTIC
HWCS	HOT WATER CLEAN SYSTEM
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HRSD	HEATED RECIRCULATED SLUDGE
L	LIME
LPO	LIQUID POLYMER
LSD	LIME SLUDGE

LEGEND	SERVICE
ML	MIXED LIQUOR
N	NITROGEN GAS
NA	SODIUM HYDROXIDE
NAC	SODIUM HYDROXIDE IN CONTAINMENT
O	OXYGEN GAS
OA	ODOROUS AIR
OF	OVERFLOW
P	PROPANE GAS
PA	PHOSPHORIC ACID
PD	PLANT DRAIN
PDSD	PRIMARY DIGESTED SLUDGE
PE	PRIMARY EFFLUENT
PI	PRIMARY INFLUENT
PLE	PLANT EFFLUENT
PLI	PLANT INFLUENT
PLR	PLANT RECYCLE
PLSD	PASTEURIZED LIME SLUDGE
PO	POLYMER SOLUTION
PSD	PRIMARY SLUDGE
PSM	PRIMARY SCUM
PW	PROCESS WASTEWATER
RANS	RETURN ANAEROBIC SLUDGE
RAS	RETURN ACTIVATED SLUDGE
RCY	RECYCLE (DAF)
RD	ROOF DRAIN
RFL	REFRIGERANT LIQUID
RFS	REFRIGERANT SUCTION
RHW	RECIRCULATED HOT WATER
RS	RAW SEWAGE
RSD	RECIRCULATED SLUDGE
RW	RAW WATER
S	SANITARY SEWER
SA	SAMPLE
SAS	SULFURIC ACID
SCN	SCREENINGS
SDG	SULFUR DIOXIDE GAS (PRESSURE)
SDS	SULFUR DIOXIDE SOLUTION
SDV	SULFUR DIOXIDE GAS (VACUUM)
SE	SECONDARY EFFLUENT
SEP	SEPTAGE
SH	SODIUM HYPOCHLORITE
SI	SECONDARY INFLUENT
SPD	SUMP PUMP DISCHARGE
SPNT	SUPERNATANT
SSM	SECONDARY SCUM
ST	STORM SEWER
SW	SCREENED WASTEWATER
TA	TREATED AIR
TSD	THICKENED SLUDGE
TDSD	THICKENED DIGESTED SLUDGE
V	VENT
VAC	VACUUM
WANS	WASTE ANAEROBIC SLUDGE
WAS	WASTE ACTIVATED SLUDGE
W1	NO.1 WATER (POTABLE)
W2	NO.2 WATER (NON POTABLE)
W3	NO. 3 WATER (PLANT EFFLUENT)
WS	WASTE SOLIDS

YARD PIPING LEGEND

NEW	EXISTING	
		NON–FREEZE HOSE VALVE X = NO. IN SPECIFICATIONS
		NON–FREEZE HOSE VALVE WITH HOSE RACK X = NO. IN SPECIFICATIONS
		GATE VALVE
		BUTTERFLY VALVE
FLOW SEATING PORT		ECCENTRIC PLUG VALVE
		INDICATOR POST VALVE
		FIRE HYDRANT
CO	CO	CLEANOUT
		CATHODIC PROTECTION TEST STATION
		CATHODIC PROTECTION ANODE

NOTE:

THIS IS A STANDARD LEGEND AND NOT ALL OF THE INFORMATION SHOWN MAY BE USED ON THIS PROJECT.

city of South Milwaukee
Proud Past ... Promising Future

Applied Technologies
Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

PROJECT REFERENCE
MECHANICAL
LEGEND

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 10-M-1

PSLTSCALE: 1 LTSCALE: 1
J:\5795 – S Mke\GRAPHICS\DRAWINGS\10-M-1 LEGEND.dwg Last Modified: 6 December 2016 Plotted On: 4/16/2018 2:37 PM by PHIL GERLACH
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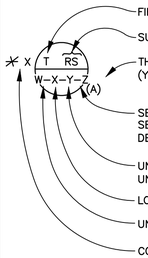
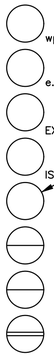
INSTRUMENTATION IDENTIFICATION

EXAMPLE SYMBOLS



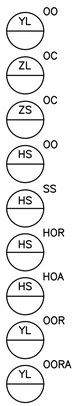
- FIRST LETTER(S)
- SUCCEEDING LETTERS
- THE TOTAL NUMBER OF UNITS PER SET (Y VARIES FROM 1 TO A)
- SET NUMBER (USED WHEN THERE ARE MULTIPLE SETS OF UNITS WITH THE SAME W–X–Y DESIGNATIONS)
- UNIT NUMBER (USED WHEN THERE ARE MULTIPLE UNITS WITH THE SAME W–X DESIGNATIONS)
- LOOP NUMBER
- UNIT PROCESS NUMBER
- COMPONENT SPECIFICATION AND FURNISH CODE @ 11:00 O'CLOCK POSITION ON SYMBOL, AS NOTED ON PANELS, PACKAGED SYSTEMS, OR OTHER I&C EQUIPMENT SYMBOLS

NONE	= SPECIFIED AND FURNISHED VIA I&C DIVISION 13710
✳ M	= SPECIFIED AND FURNISHED IN MECHANICAL/EQUIPMENT DIVISION 11 AND 15
✳ E	= SPECIFIED AND FURNISHED IN ELECTRICAL DIVISION 16
✳ P	= SPECIFIED AND FURNISHED WITH ASSOCIATED PACKAGE SYSTEM
✳ O1	= OWNER FURNISHED, OWNER INSTALLED (OFOI)
✳ O2	= OWNER FURNISHED, CONTRACTOR INSTALLED (OFCI)
EXST	= EXISTING EQUIPMENT



- FIELD MOUNTED INSTRUMENT WEATHER–PROOF
- FIELD MOUNTED INSTRUMENT EXPLOSION–PROOF
- FIELD MOUNTED INSTRUMENT EXISTING
- FIELD MOUNTED INSTRUMENT INTRINSICALLY SAFE
- FIELD MOUNTED INSTRUMENT THAT REQUIRES 120VAC AT THE DEVICE
- REAR–OF–PANEL MOUNTED INSTRUMENT
- FACE OF PANEL MOUNTED INSTRUMENT
- MOTOR CONTROL CENTER MOUNTED INSTRUMENT (FACE OF CUBICLE)

SPECIAL CASES (@ 2 O'CLOCK POSITION ON SYMBOL)



- ON AND OFF EVENT LIGHTS
- OPENED AND CLOSED POSITION LIGHTS
- OPENED AND CLOSED POSITION SWITCHES
- ON–OFF HAND SWITCH. MAINTAINED CONTACT SWITCHES (CONTROLLED DEVICE WILL RESTART ON RETURN OF POWER AFTER POWER FAILURE).
- STOP–START HAND SWITCH. MOMENTARY CONTACT SWITCHES (CONTROLLED DEVICE WILL NOT RESTART ON RETURN OF POWER AFTER POWER FAILURE).
- HAND–OFF–REMOTE HAND SWITCH. MAINTAINED CONTACT SELECTION
- HAND–OFF–AUTOMATIC HAND SWITCH. MAINTAINED CONTACT SELECTION
- ON–OFF–REMOTE EVENT LIGHTS
- ON–OFF–REMOTE–AUTO EVENT LIGHTS

INSTRUMENT SOCIETY OF AMERICA TABLE

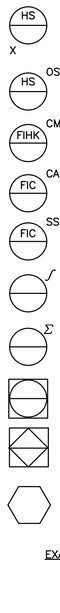
	FIRST LETTER(S)		SUCCEEDING LETTERS		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS *		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE *	USER'S CHOICE *	USER'S CHOICE *
C	USER'S CHOICE *			CONTROL	
D	USER'S CHOICE *	DIFFERENTIAL			
E	VOLTAGE		SENSOR(PRIMARY ELEMENT)		
F	FLOW RATE	RATIO(FRACTION)			
G	USER'S CHOICE *		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	USER'S CHOICE *	MOMENTARY			MIDDLE
N	USER'S CHOICE *		USER'S CHOICE *	USER'S CHOICE *	USER'S CHOICE *
O	USER'S CHOICE *		ORIFICE, RESTRICTION		
P	PRESSURE (OR VACUUM)		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE *		MULTIFUNCTION *	MULTIFUNCTION *	MULTIFUNCTION *
V	VIBRATION			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED *	X AXIS	UNCLASSIFIED *	UNCLASSIFIED *	UNCLASSIFIED *
Y	EVENT, STATE	Y AXIS		RELAY, COMPUTE, CONVERT *	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

* WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

TRANSDUCERS (@ 2 O'CLOCK POSITION ON SYMBOL)

A	ANALOG	I	CURRENT	I/I	SIGNAL ISOLATOR
D	DIGITAL	P	PNEUMATIC	R/I	RESISTANCE TO CURRENT
E	VOLTAGE	PF	PULSE FREQUENCY	CT	CURRENT TRANSFORMER
F	FREQUENCY	PD	PULSE DURATION		

INSTRUMENT PANEL LOCATION IDENTIFICATION



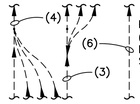
- LOCATED IN PANEL IDENTIFIED ON DRAWING "X" IS USED @ 7 O'CLOCK TO IDENTIFY PANEL LOCATION WHEN DEVICE IS NOT ON THE MCP OR OTHERWISE INDICATED ON DRAWING.
- OPEN–STOP–CLOSE MOMENTARY CONTACT CONTROL SWITCH
- FLOW INDICATING, COMPUTER/MANUAL CONTROL STATION
- FLOW INDICATING, COMPUTER/AUTO/MANUAL CONTROL STATION
- FLOW INDICATING SUPERVISORY SET POINT (BY COMPUTER), AUTO/MANUAL CONTROL STATION
- INTEGRAL
- SUMMATION
- SOFTWARE OPERATOR INTERFACE
- PROGRAMMABLE CONTROLLER INPUT OR OUTPUT
- TELEMETRY INPUT OR OUTPUT

EXAMPLE:

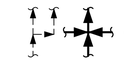
CURRENT TO PNEUMATIC TRANSDUCER (BACK OF PANEL, IN A FLOW LOOP)

LINE LEGEND

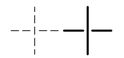
- PRIMARY PROCESS (CLOSED CONDUIT)
- SECONDARY PROCESS
- TERTIARY PROCESS
- DISCRETE SIGNAL (ON/OFF ETC.)
- –A– ANALOG SIGNAL (4 TO 20 mA DC, ETC.)
- –PF– PULSE FREQUENCY SIGNAL
- –DH– DATA HIGHWAY CABLE
- –PD– PULSE DURATION SIGNAL
- –COM– MISC. DIGITAL DATA SIGNAL COMMUNICATIONS
- –O–O– SOFTWARE LINK
- PNEUMATIC SIGNAL
- FILLED SYSTEM SIGNAL
- HYDRAULIC SYSTEM SIGNAL



PARALLEL LINES. (PARENTHETICAL NUMBER INDICATES THE NUMBER OF SIGNALS REPRESENTED

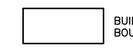


CONNECTING LINES



NON–CONNECTING LINES

PROCESS (OPEN CHANNEL)



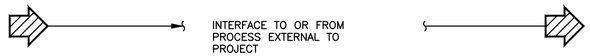
BUILDING OR FACILITY BOUNDARY

DASHED LINE INDICATES COMPONENTS SUPPLIED AS A COMPLETE PACKAGE SYSTEM OR AS NOTED

PHANTOM LINE INDICATES TYPICAL FUNCTIONS FOR SIMILAR PROCESS SYSTEMS AS NOTED

INTERFACE SYMBOLS

	= PROCESS INTERFACE
	= SIGNAL INTERFACE
W	= UNIT PROCESS NO.
A	= INTERFACE LETTER
D	= DESTINATION SHEET NO.
S	= SOURCE SHEET NO.



INTERFACE TO OR FROM PROCESS EXTERNAL TO PROJECT

SELF CONTAINED VALVE AND EQUIPMENT TAG NUMBERS

D–W–X–Y

D: P = PUMP
T = TANK
M = MECHANICAL EQUIPMENT
G = GATE
E = EJECTOR
PSE = RUPTURE DISK
ARV = AIR RELEASE VALVE
AVRV = AIR AND VACUUM RELEASE VALVE
PSV = PRESSURE RELIEF VALVE
PCV = PRESSURE CONTROL VALVE
LCV = LEVEL CONTROL VALVE
TCV = TEMPERATURE CONTROL VALVE

W = UNIT PROCESS NUMBER
X = LOOP NUMBER
Y = UNIT NUMBER

ABBREVIATIONS & LETTER SYMBOLS

AC	ALTERNATING CURRENT
ALKY	ALKALINITY
AM	AUTO–MANUAL
BCP	BUILDING CONTROL PANEL
CAM	COMPUTER–AUTO–MANUAL
Cl_2	CHLORINE
CM	COMPUTER–MANUAL
COD	CHEMICAL OXYGEN DEMAND
DC	DIRECT CURRENT
DCP	DIGESTER CONTROL PANEL
DO	DISSOLVED OXYGEN
FCl_2	FREE CHLORINE RESIDUAL
FOS	FAST–OFF–SLOW
FOSA	FAST–OFF–SLOW–AUTO
FOSR	FAST–OFF–SLOW–REMOTE
FR	FORWARD–REVERSE
HDNS	HARDNESS
HOA	HAND–OFF–AUTO
HOR	HAND–OFF–REMOTE
H_2S	HYDROGEN SULFIDE
LCP–W–X	LOCAL CONTROL PANEL (W=UNIT PROCESS NUMBER, X=PANEL NUMBER)
LEL	LOWER EXPLOSIVE LIMIT
LOS	LOCKOUT STOP
LR	LOCAL REMOTE
MA	MANUAL–AUTO
MC	MODULATE–CLOSE
MCC–X	MOTOR CONTROL CENTER NO. X
MCP	MAIN CONTROL PANEL (IN CENTRAL CONTROL ROOM)
OC	OPEN–CLOSE (D)
OCA	OPEN–CLOSE–AUTO
OCR	OPEN–CLOSE–REMOTE
OO	OFF–ON
OOA	OFF–ON–AUTO
OOR	OFF–ON–REMOTE
PCP	PROCESS CONTROL PANEL
OSC	OPEN–STOP–CLOSE
pH	HYDROGEN ION CONCENTRATION
RM–X	REMOTE MULTIPLEXING MODULE NO. X
RTD	RESISTANCE TEMPERATURE DETECTOR
SF	SLOWER–FASTER
SS	START–STOP
SSC	SUPERVISORY SET POINT CONTROL
TC	THERMOCOUPLE
VIB	VIBRATION
D	DIFFERENCE
n	SUM
X	MULTIPLY
/	DIVIDE
f(x)	CHARACTERIZED
X^n	RAISE TO THE Nth POWER
e	SQUARE ROOT
AVG	AVERAGE
1:1	REPEAT OR BOOST
>	SELECT HIGHEST SIGNAL
<	SELECT LOWEST SIGNAL

GENERAL NOTES

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SOUTH MILWAUKEE, WISCONSIN

PROJECT REFERENCE
INSTRUMENTATION & CONTROL
LEGEND

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 10-I-1

PSLTSCALE: 1 LTSCALE: 1
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VALVE SYMBOLS

- GATE
- KNIFE GATE
- BUTTERFLY
- GLOBE
- BALL
- VEE–BALL
- PLUG
- SEAT PORT ECCENTRIC PLUG
- DIAPHRAGM
- PINCH
- NEEDLE
- SWING CHECK
- BALL CHECK
- TRIPLE DUTY
- SAMPLE
- MUD
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELIEF
- REGULATED SIDE PRESSURE CONTROL
- MULTI–PORT VALVES (BALL VALVE SHOWN. FOR OTHER VALVE TYPES, APPROPRIATE VALVE SYMBOL SHOWN.) ARROWS INDICATE FLOW PATTERN. SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- CENTER PIVOT CHECK VALVE

GATE SYMBOLS

- SLUICE
- BUTTERFLY
- FLAP
- FABRICATED SLIDE
- SHEAR

ACTUATOR SYMBOLS

- PZ XX — PNEUMATIC W/POSITIONER
- PS XX — PNEUMATIC W/SOLENOID
- E XX — ELECTRIC
- EZ XX — ELECTRIC W/POSITIONER
- H XX — HYDRAULIC
- S — SOLENOID
- PB XX — PNEUMATIC W/ VOLUME BOOSTER

NOTE:
ON LOSS OF PRIMARY POWER (PNEUMATIC OR ELECTRICAL)

XX: FO = FAIL OPEN
FC = FAIL CLOSED
FLP = FAIL TO LAST POSITION

MOTOR CONTROL INTERFACE

MS @ MCC

MOTOR STARTER (MS) AND CONTROL LOGIC FUNCTIONS–FUNCTION LOCATED IN MOTOR CONTROL CENTER (MCC)

REFER TO CONTROL DIAGRAMS FOR TYPICAL FUNCTIONS EACH MOTOR STARTER COMPARTMENT REQUIRES FRONT MOUNTED PUSH–TO–TEST ON LIGHT, RUN TIME METER, MECH. OL RESET PUSHBUTTON

MISCELLANEOUS SYMBOLS

- SIGHT GLASS
- DIAPHRAGM SEAL
- BLIND FLANGE
- AIR GAP
- VENT TO ATMOSPHERE
- AERATOR
- PLUG
- RECEPTACLE
- A — SELF CONTAINED AIR SUPPLY
- SD D — COMPOSITE SAMPLER (DIPPER TYPE)
- SS — COMPOSITE SAMPLER (SUCTION TYPE)
- TV — TV CAMERA
- RADIO ANTENNA
- A ON–TD X–SEC B — "ON" TIME DELAY: B "ON" X–SEC. AFTER A "ON". INSTANT "OFF"
- A OFF–TD X–SEC B — "OFF" TIME DELAY B "OFF" X–SEC. AFTER A "OFF". INSTANT "ON"
- I — INTERLOCK. SEE CONTROL DIAGRAMS AND LOOP DESCRIPTIONS FOR FUNCTION.
- OR I
- A B S R C — MEMORY ELEMENT S=SET, R=RESET
- XA — PURGE SET X: W=WATER A=AIR
- SEE
- RTU–XXX — REMOTE TELEMETRY UNIT
- STRAINER, Y TYPE
- (J) = ELECTRICAL JUNCTION DEVICE – SPECIFIED IN I & C SECTION
- xxxV — xxx VOLT, POWER SUPPLY POINT, (480 VOLT = 3 PHASE POWER) (208 VOLT = 1 PHASE POWER)
- ANNULAR DIAPHRAGM SEAL
- RUPTURE DISK
- PIG INSERT POINT
- OR — PIG CATCH POINT
- OR M — MIXER
- M — ELECTRIC MOTOR
- PRESSURE GAUGE
- X — TONE TRANSMITTER NO. X
- X — TONE RECEIVER NO. X
- VOICE COMMUNICATION POINT
- TV — TV MONITOR
- A B C AND — LOGIC ELEMENT: IF A AND NOT B THEN C
- A B C OR — LOGIC ELEMENT: IF A OR B THEN C
- S R — ON/OFF RELAY. INPUT IS CONNECTED TO OUTPUT WHEN SWITCHING SIGNAL IS PRESENT
- S R — SWITCHING SIGNAL: SWITCHING RELAY. INPUT WITH DOT IS CONNECTED TO OUTPUT WHEN SWITCHING SIGNAL IS PRESENT.
- OTHER INPUT IS CONNECTED TO OUTPUT WHEN SWITCHING SIGNAL IS NOT PRESENT.
- F — FLUSHING CONNECTION: HOSE ADAPTOR
- S — SEAL WATER SET: SIGHT FLOW GAUGE
- XX — AIR SET: XX = SUPPLY PRESSURE IN PSIG.
- FILTER/ REGULATOR/ GAUGE SET
- 240V OR 120V — TC — HEAT TRACE FURNISHED BY OTHERS PER DIVISION 16

PUMP COMPRESSOR SYMBOLS

NOTE:
XX: ASVT ADJUSTABLE SPEED VARIABLE TORQUE
ASCT ADJUSTABLE SPEED CONSTANT TORQUE
TS TWO SPEED

- CENTRIFUGAL PUMP (DRY PIT) XX
- CENTRIFUGAL PUMP (WET PIT) XX
- CHEMICAL FEED PUMP XX
- DIAPHRAGM PUMP XX
- LOBE PUMP (POSITIVE DISPLACEMENT) XX
- PISTON PUMP XX
- GAS COMPRESSOR (LIQUID RING)
- PROGRESSIVE CAVITY PUMP XX
- SUBMERSIBLE SUMP PUMP XX
- COMPRESSOR (CENTRIFUGAL) OR BLOWER XX
- COMPRESSOR (PISTON) XX
- EJECTOR
- COMPRESSOR OR BLOWER (POSITIVE DISPLACEMENT) XX
- PERISTALTIC PUMP

PRIMARY ELEMENT SYMBOLS

- PARSHALL FLUME
- WEIR
- ORIFICE PLATE
- FLOW TUBE
- PITOT–STATIC
- ULTRASONIC FLOWMETER
- ULTRASONIC FLOWMETER (CLAMP–ON)
- PROPELLER OR TURBINE METER
- ELECTROMAGNETIC FLOWMETER
- LEVEL (BUBBLE TUBE)
- LEVEL (FLOAT)
- LEVEL (ULTRASONIC OR RADAR)
- ROTAMETER
- X — DENSITY METER (X: N = NUCLEAR O = OPTICAL U = ULTRASONIC)
- FE 0–0–0 — THERMAL DISPERSION FLOWMETER
- D.O. AE 0–0–0 — DISSOLVED OXYGEN D.O. SENSOR
- TE 0–0–0 — TEMPERATURE ELEMENT

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LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
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PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 10-I-2

PSLTSCALE: 1 LTSCALE: 1
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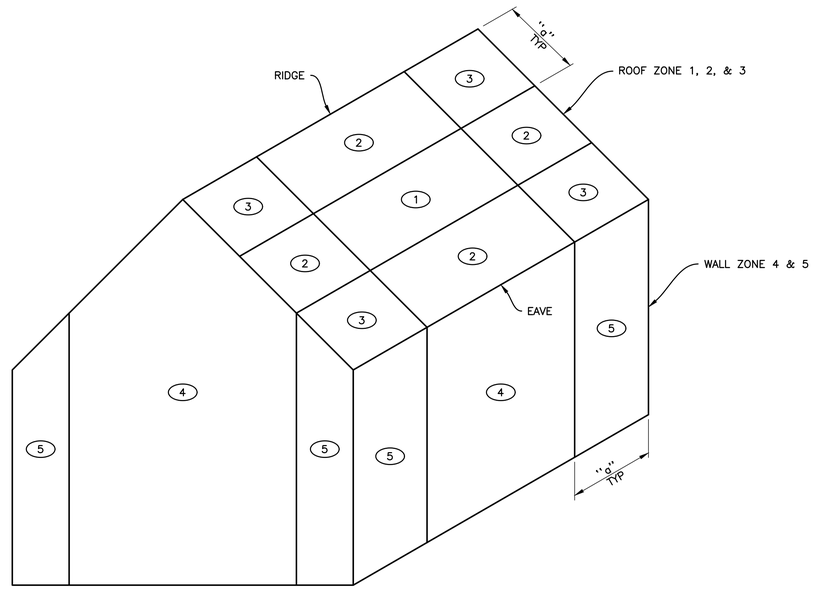
LIFT STATION - STRUCTURAL DATA	
GOVERNING CODE	2009 IBC
LOADING INFORMATION	
DEAD LOADS	
ROOFING	5 PSF
TRUSSES	10 PSF
CEILINGS	5 PSF
MECHANICAL/ELECTRICAL	5 PSF
TOTAL ROOF LOAD	25 PSF
LIVE LOADS	
MINIMUM ROOF LIVE LOAD	20 PSF
FLOOR LOAD	150 PSF
WATER LOAD	62.4 PCF
ROOF SNOW LOAD	
GROUND SNOW LOAD (Pg)	30 PSF
SNOW EXPOSURE FACTOR (Ce)	0.9
SNOW LOAD IMPORTANCE FACTOR (Is)	1.1
THERMAL FACTOR (Cf)	1.1
BALANCED SNOW LOAD	13.7 PSF
WIND LOADING	
ULTIMATE DESIGN WIND SPEED (Vult)	120 MPH
NOMINAL DESIGN WIND SPEED (Vasd)	93 MPH
RISK CATEGORY	III
WIND EXPOSURE	C
INTERNAL PRESSURE COEFFICIENT	0.18
DESIGN PRESSURE	SEE SCHEDULE
SEISMIC LOADING	
RISK CATEGORY	III
SEISMIC IMPORTANCE FACTOR (Ie)	1.25
MAPPED SPECTRAL RESPONSE ACCELERATION	
Ss=	0.098
S1=	0.055
SITE CLASS	D
SPECTRAL RESPONSE COEFFICIENTS	
SDS=	0.105
SD1=	0.088
SEISMIC DESIGN CATEGORY	A
BASIC SEISMIC RESISTING SYSTEM	REINFORCED CMU
SEISMIC REPONSE COEFFICIENT (Cs)	0.069
ANALYSIS PROCEDURE USED	MIN. LATERAL FORCE PROCEDURE
GEOTECHNICAL INFORMATION	
ALLOWABLE BEARING PRESSURE	2000 PSF
GILES REPORT NO. 1G-1605002 DATED JUNE 16, 2016	

NOMINAL WIND PRESSURES (ASCE 7-10)									
BUILDING NUMBER	Vult (MPH)	Vasd (MPH)	END ZONE WIDTH (FT)	TRIBUTARY AREA (S.F.)	ROOF ZONES				WALL ZONES
					ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
LIFT STATION	120	93	3.3 FT	10 S.F.	-15.54	-18.18	-18.18	-16.86	-20.82
					+14.22	+14.22	+14.22	+15.54	+15.54
				20 S.F.	-14.76	-17.40	-17.40	-16.14	-19.44
					+13.80	+13.80	+13.80	+14.82	+14.82
				50 S.F.	-13.68	-16.32	-16.32	-15.24	-17.58
					+13.32	+13.32	+13.32	+13.92	+13.92
				100 S.F.	-12.90	-15.54	-15.54	-14.52	-16.14
					+12.90	+12.90	+12.90	+13.20	+13.20

NOTES:

1. GROSS PRESSURES SHALL BE LINEARLY INTERPOLATED FOR AREA (A) NOT SHOWN IN TABLE.
2. GROSS PRESSURES ARE FOR JOISTS, WINDOWS, DOORS, VENEER, ROOFING, ROOF ACCESSORIES, DECKING, FLASHING, AND OTHER BUILDING COMPONENTS AND CLADDING.
3. POSITIVE PRESSURES INDICATE PRESSURES ACTING TOWARDS A PROJECTED SURFACE. NEGATIVE PRESSURES INDICATE PRESSURES ACTING AWAY FROM A PROJECTED SURFACE.
4. INTERNAL PRESSURE COEFFICIENT FOR BUILDINGS IS AS FOLLOWS:
   a. ENCLOSED BUILDING COEFFICIENT +0.18 AND −0.18
   b. OPEN STRUCTURE COEFFICIENT +0.00 AND −0.00
   c. PARTIALLY ENCLOSED STRUCTURE COEFFICIENT +0.55 AND − 0.55
5. NET DESIGN ROOF PRESSURES SHALL BE CALCULATED USING THE SELF WEIGHT (DEAD LOAD) OF THE MATERIALS. HOWEVER, THE MAXIMUM REDUCTION OF WIND UPLIFT PRESSURES SHALL BE LIMITED TO THE SELF WEIGHT OF THE ROOF SYSTEM PLUS 5 PSF FOR SUPERIMPOSED DEAD LOADS.

CODE DATA		
WISCONSIN COMMERCIAL BUILDING CODE (IBC 2009)		
CODE DATA	PROPOSED	CODE REFERENCE
USE AND OCCUPANNCY	F-2	S-301
ALLOWABLE AREA PER FLOOR	13,000 SF	T-503
ACTUAL AREA	1,109 SF	T-503
ALLOWABLE HEIGHT	2 STORIES 40 FEET	T-503
ACTUAL HEIGHT	1 STORY 21'-8"	CALCULATED
CONSTRUCTION TYPE	5B	T-601
FIRE SEPARATION REQUIREMENTS	EMERGENCY POWER GENERATOR - GENERATOR ROOM SEPARATION: 1 HOUR FIRE BARRIER, 1 HOUR CEILING	NFPA 37
OCCUPANCY RATE	500 SF / OCC	T-1004.1.1
OCCUPANCY LOAD	PER CODE: 3 OCC ACTURAL: 0 OCC	CALCULATED
PLUMBING FACILITIES	NONE - BUILDING NOT OCCUPIED	T-2902.1
PROJECT VOLUME	19,228 CU. FT.	CALCULATED



BUILDING WIND PRESSURE DIAGRAM

NTS

city of South Milwaukee
Proud Past ... Promising Future

AppliedTechnologies
Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

PROJECT REFERENCE
ARCHITECTURAL/STRUCTURAL
CODE DATA & WIND LOADS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: B.A.G.
DRAWN BY: J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO.
5795

DATE
APRIL 2018

DRAWING NO.
10-AS-1

PSLTSCALE: 1 LTSCALE: 1
J:\5795 - S Mke\GRAPHICS\DRAWINGS\10-AS-1 CODE DATA & WIND LOADS.dwg Last Modified: 13 April 2018 Plotted On: 4/16/2018 8:23:37 PM By: PHILLIGDER\BGH
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LAKE DR. L.S.
SEE 13960

RAVINE L.S.
SEE 13960

SOUTH MILWAUKEE WWTF
SEE NETWORK DIAGRAM

LIFT STATION 6
SEE 13960

SOUTHEAST L.S.
SEE 13961

N. CHICAGO L.S.
SEE 13960

SOUTH MILWAUKEE
WATER TOWER
SEE 13960

SIPHON CROSSING
SEE 13960

MISSOURI L.S.
SEE 13960

MARQUETTE RELIEF L.S.
(CONTROLLED FROM
SIPHON CROSSING)

CHESTNUT RELIEF L.S.
SEE 13960

17th AND OAK RELIEF L.S.
SEE 13960

GRANT PARK

RAWSON PARK

OAK CREEK PARKWAY

PUBLIC SCHOOL SITE

UNION PACIFIC RAILWAY

LAKE MICHIGAN

PLAN

N
PLAN NORTH

0 500' 1000' 1500' 2000'
GRAPHIC SCALE

city of South Milwaukee
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NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SITE WORK
GENERAL
PROJECT LOCATIONS

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY:	K.R.H.
DRAWN BY:	J.T.H.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	20-G-1

PSLTSCALE: 1 LTSCALE: 1
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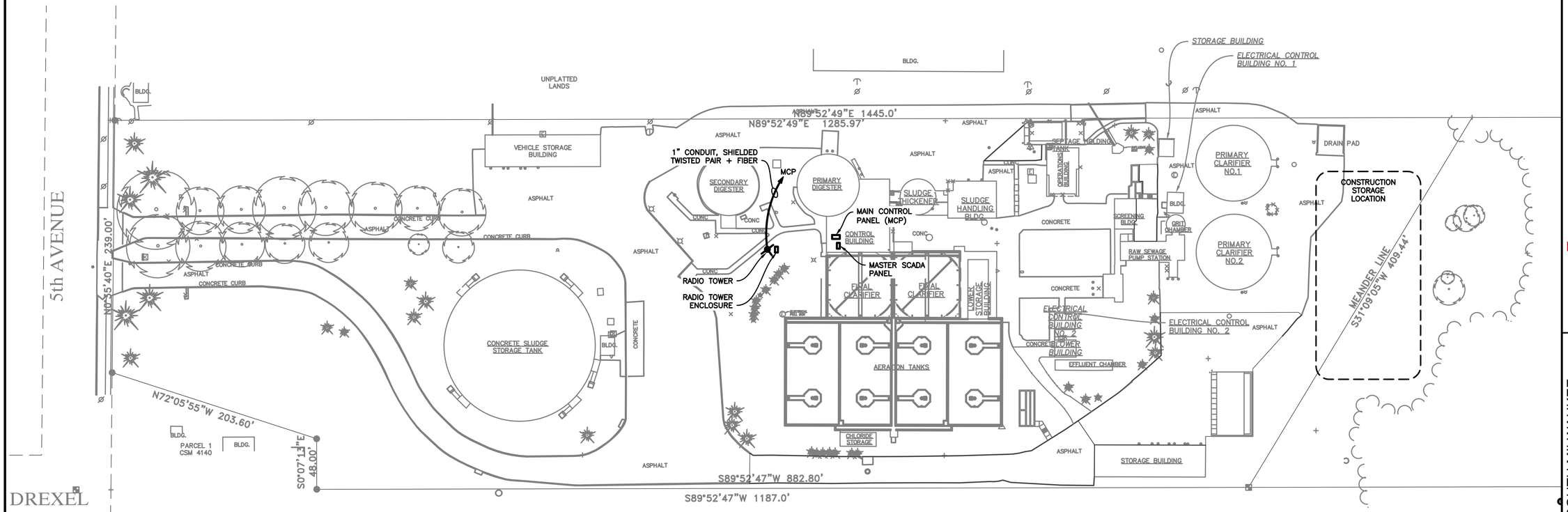
NOTES:

1. SEE SPECIFICATION SECTION 13323 FOR ANTENNA CABLE REQUIREMENTS.



WWTF OVERALL SITE PLAN

PLAN NORTH

0 50' 100' 150' 200'

GRAPHIC SCALE

city of South Milwaukee — Proud Past ... Promising Future

Applied Technologies Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SITE WORK
GENERAL
WWTF OVERALL PLAN

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 20-G-2

PSLTSCALE: 1 LTSCALE: 1
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OAK CREEK
CREEK W.S. 619.38

728-9923

REMOVE MANHOLE
REMOVE SEWER, TYP
REMOVE OUTFALL
EXISTING OVERGROWN RIPRAP
REMOVE 12" PVC
REMOVE 30" SANITARY SEWER
REMOVE MANHOLE
REMOVE MANHOLE
REMOVE 24" STM SEWER
REMOVE 8" SANITARY SEWER
REMOVE PAVEMENT
REMOVE MANHOLE
EXISTING LIFT STATION
REMOVE LIFT STATION, SEE 20-R-2 FOR REMOVAL REQUIREMENTS
EXST UTILITY XFMR, SEE NOTE 5
REMOVE 10" AND 14" FM
REMOVE 2" W1
EXST LIGHT POLE. CONTRACTOR TO COORDINATE WITH OWNER FOR RELOCATION. SEE DWG 20-ME-1 FOR NEW LOCATION.
STM MH 1 (Z14)
B-1
B-2
SAN MH E1
SAN MH E1-A
SAN MH E2
SAN MH E1-1
STM MH 2 (Z13)
STM MH B
STM MH A (Z12)
STM CB Z12B
STM CB Z12A
TELE MH
LIGHT POLE
CHICAGO AVENUE
CONCRETE
GARAGE
APT. BLDG.
728-9952
SAW CUT AND REMOVE EXST APRON AND SIDEWALK TO NEAREST JOINT
SAWCUT AND REMOVE CONCRETE PAVEMENT TO NEAREST JOINT
PROVIDE REPAIR SLEEVE
SAWCUT AND REMOVE CURB AND GUTTER TO NEAREST JOINT
SAWCUT AND REMOVE EXISTING SIDEWALK TO MATCH EXISTING TO NEAREST JOINT
8" WAT
12.0'
14" FM
10" FM

REMOVAL NOTES:

1. CONTRACTOR TO FIELD VERIFY EXISTING DIMENSIONS AND CONDITIONS RELATED TO CONSTRUCTION AND MAKE MINOR ADJUSTMENTS AS REQUIRED. REPORT SIGNIFICANT VARIATION TO ENGINEER.
2. REMOVE PIPING SHOWN TO THE NEAREST PIPE JOINT.
3. CAP OR BLIND FLANGE ALL ABANDONED PIPING.
4. ABANDON THE 10-INCH AND 14-INCH DIAMETER FORCE MAINS BY FILLING EACH PIPE WITH ELASTIZELL CELLULAR CONCRETE, TYPE PS120, OR EQUAL
5. EXISTING TRANSFORMER TO BE REMOVED BY UTILITY. SECONDARY CONDUCTORS TO BE REMOVED BY CONTRACTOR. REFER TO SPECIFICATIONS TO COORDINATE REMOVAL.

EXISTING STRUCTURES

SAN MH E1
RIM 634.78
10" SE IE 631.25
8" N IE 626.48
15" W IE 623.80
30" N & SE IE 620.58

SAN MH E1-1
RIM 638.34
15" SW IE 634.32
15" E IE 629.59

SAN MH E2
(BURIED)

SAN MH E3
RIM 631.64
NE IE 621.09
SE IE 621.04

SAN BACKWATER VALVE MH
RIM 631.34

SAN MH E1-A
RIM 633.68
8" E IE 626.97
8" S IE 626.95

SAN MH E1-B
RIM 640.77
8" S IE 633.95
8" W IE 633.63

STM MH 1
RIM 632.21
24" SW IE 626.54
24" NE IE 620.69

STM MH 2
RIM 639.16
24" SW IE 633.06
24" NE IE 630.71

STM MH A
RIM 636.30

STM MH B
RIM 640.83
-9.25 IE

N
PLAN NORTH

SITE REMOVAL PLAN

0 10' 20' 30' 40'
GRAPHIC SCALE

city of South Milwaukee
Proud Past ... Promising Future

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AppliedTechnologies Engineers-Architects

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SITE WORK REMOVAL PLAN

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 20-R-1

PSLTSCALE: 1 LTSCALE: 1
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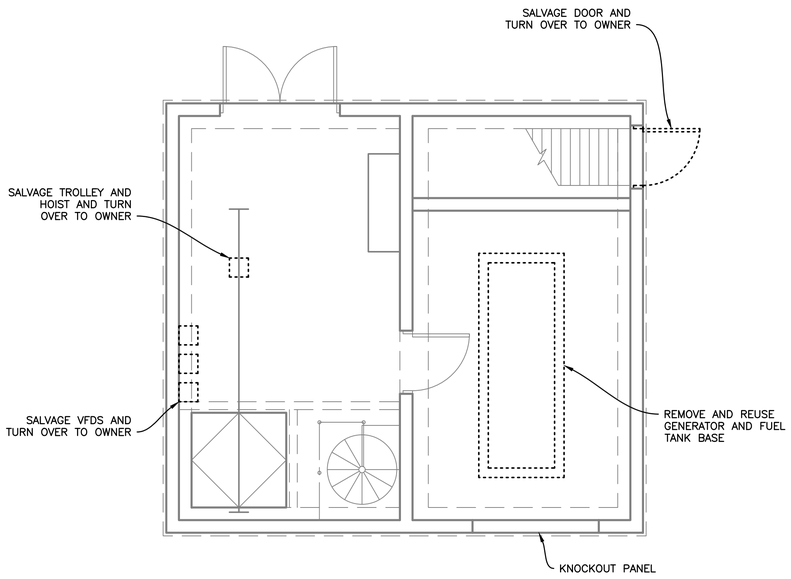
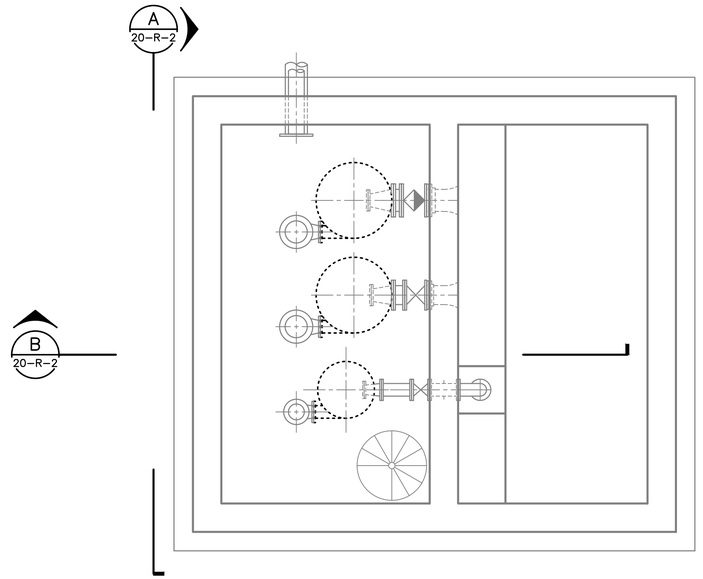


N

GRADE FLOOR PLAN

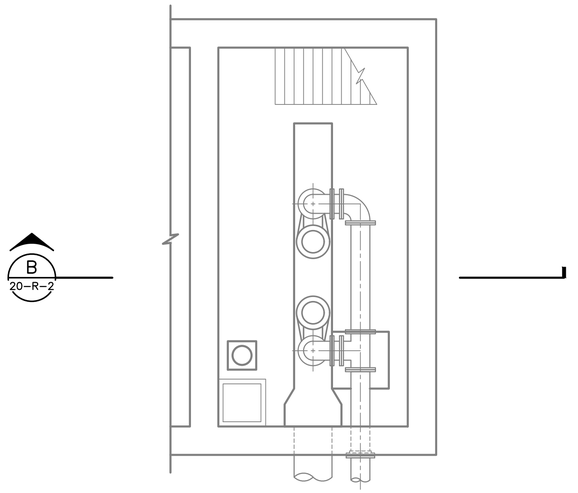
1/4" = 1'-0"



N

PUMP WELL PLAN

1/4" = 1'-0"

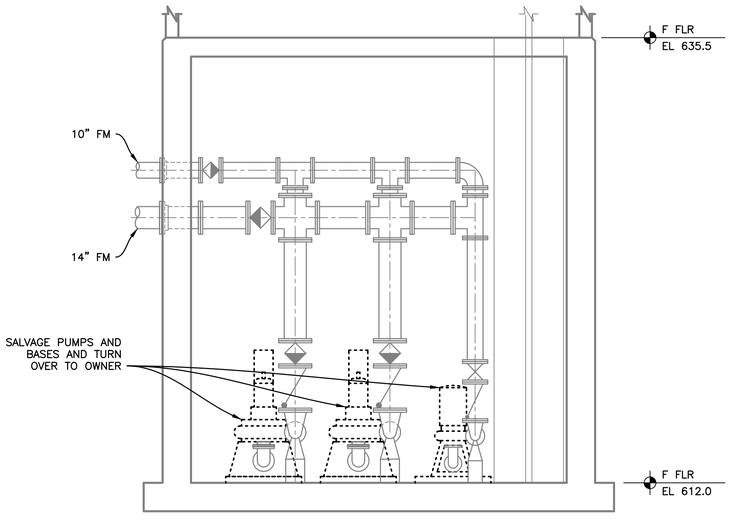


COMMINUTOR ROOM
F FLR EL 625.0

N

PARTIAL PLAN

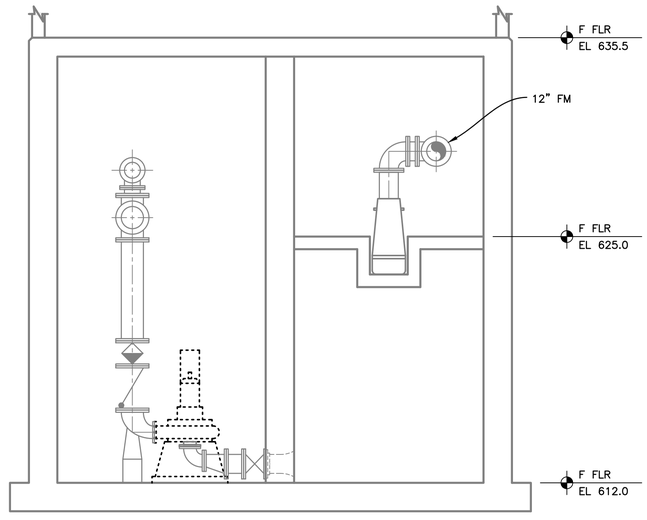
1/4" = 1'-0"



A 20-R-2

SECTION

1/4" = 1'-0"



B 20-R-2

SECTION

1/4" = 1'-0"

REMOVAL NOTES

1. FIELD VERIFY EXISTING DIMENSIONS, ELEVATIONS AND CONDITION OF EXISTING STRUCTURE.
2. CONTRACTOR SHALL REMOVE AND DELIVER CITY EQUIPMENT AND PROPERTY TO ACCEPTABLE LOCATIONS AS SPECIFIED IN SECTION 02221.
3. CONTRACTOR SHALL REMOVE AND DISPOSE OF ALL PUMPING EQUIPMENT, PIPING, HVAC DUCTS, AND ELECTRICAL EQUIPMENT AND CONDUIT.
4. CONTRACTOR SHALL COMPLETELY REMOVE AND DISPOSE OF ALL EXISTING ABANDONED PIPES AND MANHOLE STRUCTURES THAT MAY HINDER NEW CONSTRUCTION AND/OR ARE AT OR ABOVE 24" BELOW FINISHED GRADE.
5. CONTRACTOR SHALL COMPLETELY REMOVE AND DISPOSE OF ENTIRE ABOVE GRADE STRUCTURE, INCLUDING ALL CONCRETE FOUNDATION WALLS AND FOOTINGS AT OR ABOVE 24" BELOW FINISHED GRADE.
6. CONTRACTOR SHALL PUNCH OR DRILL HOLES IN THE BASE OF THE REMAINING STRUCTURE TO ALLOW FOR DRAINAGE.
7. CONTRACTOR SHALL BACKFILL STRUCTURE IN ACCORDANCE WITH SPECIFICATIONS AND PROVIDE SURFACE RESTORATION.

city of South Milwaukee — Proud Past ... Promising Future

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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SITE WORK
REMOVAL
PLANS AND SECTIONS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	K.R.H.
DRAWN BY:	P.C.G./J.T.H.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	20-R-2

PSLTSCALE: 1 LTSCALE: 1
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BENCHMARKS

BM NO.	DESCRIPTION/LOCATION	ELEV.
1	CONCRETE MONUMENT WITH BRASS CAP LOCATED AT THE NORTH QUARTER CORNER OF U.S.P.L.S. SEC 11, T5N, R22E	661.91 (NGVD 1929)
2	NORTHEAST INVERT OF STM MH 2 LOCATED AS SHOWN NEAR SOUTHWEST PROPERTY CORNER	630.71 (NGVD 1929)

FEMA FLOOD ELEVATIONS:

SECTION Z – AT WEST SIDE OF CHICAGO AVENUE BRIDGE, EL 625.5 (NGVD 1929)

SECTION AA – 158 FEET WEST OF WEST SIDE OF CHICAGO AVENUE BRIDGE, EL 626.9 (NGVD 1929)

EXISTING STRUCTURES

SAN MH E1–1
RIM 638.34
15" SW IE 634.32
8" E IE 629.85 (NEW)
15" N IE 629.60 (NEW)

SAN MH E3
RIM 631.64
NE IE 621.09
SE IE 621.04

SAN BACKWATER VALVE MH
RIM 631.34

SAN MH E1–B
RIM 640.77
8" S IE 633.95
8" W IE 633.63 (NEW)

STM MH 2
RIM 639.16
24" SW IE 633.06
24" NE IE 630.71

STM MH A
RIM 636.30

STM MH B
RIM 640.83

NEW STRUCTURES

SAN MH E1
RIM 633.56
15" S IE 627.25 (DROP)
30" NW IE 620.87 (EXST)
30" SE IE 620.70
BOT EL 620.20

STM MH 1
RIM 634.79
24" SW IE 629.09 (EXST)
24" NE IE 629.09

SAN MH E1–A
RIM 637.70
8" SE IE 630.92 (EXST)
8" W IE 630.75

NOTES:

1. CONTRACTOR TO FIELD VERIFY EXISTING DIMENSIONS AND CONDITIONS RELATED TO CONSTRUCTION AND MAKE MINOR ADJUSTMENTS AS REQUIRED. REPORT SIGNIFICANT VARIATION TO ENGINEER.
2. SEE SPECIFICATION 01100 FOR SEQUENCING REQUIREMENTS. SEE SPECIFICATION 02315 FOR EXCAVATION, SHORING, AND BRACING REQUIREMENTS. SEE SPECIFICATION 01500 FOR TEMPORARY BYPASS PUMPING REQUIREMENTS.
3. DEWATERING SHALL COMPLY WITH WDNR TECHNICAL STD 1061.
4. ADDITIONAL CONSTRUCTION STORAGE AREA IS AVAILABLE AT THE WWTF SITE AND CITY OWNED PROPERTY.
5. ALL SLOPES 4:1 OR GREATER SHALL BE EROSION MATTED IN ACCORDANCE WITH WDNR TECHNICAL STD 1052.
6. SEEDING SHALL CONFORM TO WDNR TECHNICAL STD 1059. SEED MIX SHALL BE WDOT MIXTURE #10 APPLIED AT 4 LBS/1000 SQ FT.

FLARED END SECTION, INV EL 626.00 SEE 02580
PROVIDE RIP-RAP TO REDUCE SCOUR FROM PIPE DISCHARGE. GROUT AS NECESSARY TO SUPPLEMENT EXISTING RIP-RAP SLOPE, SEE 02830
CONC MOW STRIP, SEE 02015
RESTORE EXISTING RIPRAP DISTURBED BY PIPE REMOVAL AND INSTALLATION.
SILT FENCE, TYP SEE 02840
EXISTING OVERGROWN RIPRAP
SAN MH E1 SEE DETAIL 1 / 20-C-2
EROSION BALES, TYP SEE 02860
53 LF 30" SW @ 0.38%
60 LF 24" @ 4.66%
42 LF 15" SW @ 5.6%
B-1 30 LIFT STATION F FLR = 635.50
B-2
STM MH 1
139 LF 8" SAN @ 0.65%
OLD FOUNDATION REMAINING
BM 2
STM MH 2 (Z13)
CONCRETE PAVEMENT, SEE 02132
STOOP, SEE 03319
SIDEWALK TRENCH FROM DOWNSPOUT, SEE 07905
CLEAR BRUSH AS NEEDED FOR DRIVEWAY CONSTRUCTION
SAN MH E1–A
TYPICAL CONCRETE WALK, SEE 02120
TYPE D INLET PROTECTION, SEE 02544
STM CB Z12B
STM MH A (Z12)
CONCRETE PAVEMENT, SEE 02132
STM CB Z12A
CRUSHED STONE TRACKING PAD AT DRIVEWAY, SEE 02835
76 LF 8" SAN @ 3.57%
CONCRETE WALK, SEE 02120
FLARED CONCRETE DRIVEWAY SEE 02127
RELOCATED LIGHT POLE
CURB AND GUTTER, SEE 02101
SAN MH E1–B
SAN BACKWATER VALVE MH
SAN MH E3
728-9923
728-9952
GARAGE
APT. BLDG.
OAK CREEK
CREEK W.S. 619.38
WOODS
BRUSH
CHICAGO AVENUE
CURB
R/W
P/L
SAN
SW
FM
ST
W
G
E
T
TELE MH
LP
PP
GUY
GUY ROPE
FENCE
ELEC
WAT
WB
LIGHT POLE

N
PLAN NORTH

SITE PLAN

0 10' 20' 30' 40'
GRAPHIC SCALE

city of South Milwaukee
Proud Past ... Promising Future

Applied Technologies
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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SITE WORK
CIVIL
PLAN

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	P.C.G./K.R.H.
DRAWN BY:	P.C.G.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	20-C-1

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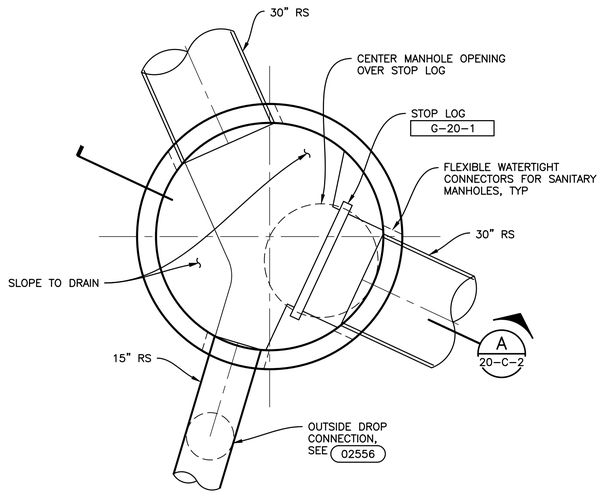
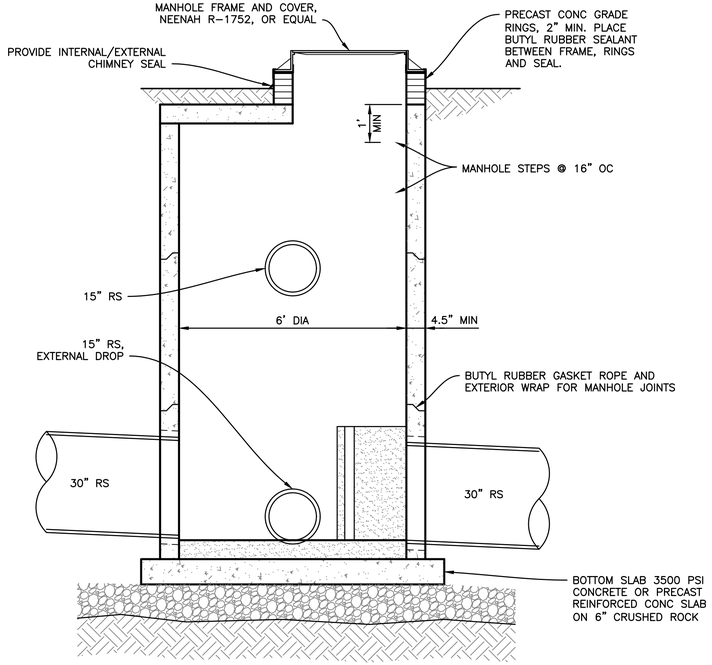
	HYDRAULIC GATE SCHEDULE										
GATE NUMBER	GATE LOCATION	GATE TYPE	FRAME TYPE	DIMENSIONS				DESIGN OPERATING HEAD (E)		OPERATOR	REMARKS
				CLEAR WIDTH	LOG HEIGHT	LOG QUANTITY	FRAME HEIGHT	SEATING	UNSEATING		
G-20-1	SAN MH E1	Stop Log	Embedded	2'-10"	9"	4	3'-0"	3'-0"	N/A	Manual	



SANITARY MANHOLE E1

1 DETAIL
20-C-1 1" = 2'



SANITARY MANHOLE E1

A SECTION
20-C-2 1" = 2'

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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SITE WORK
CIVIL
DETAIL

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO.
5795

DATE
APRIL 2018

DRAWING NO.
20-C-2

PSLTSCALE: 1 LTSCALE: 1
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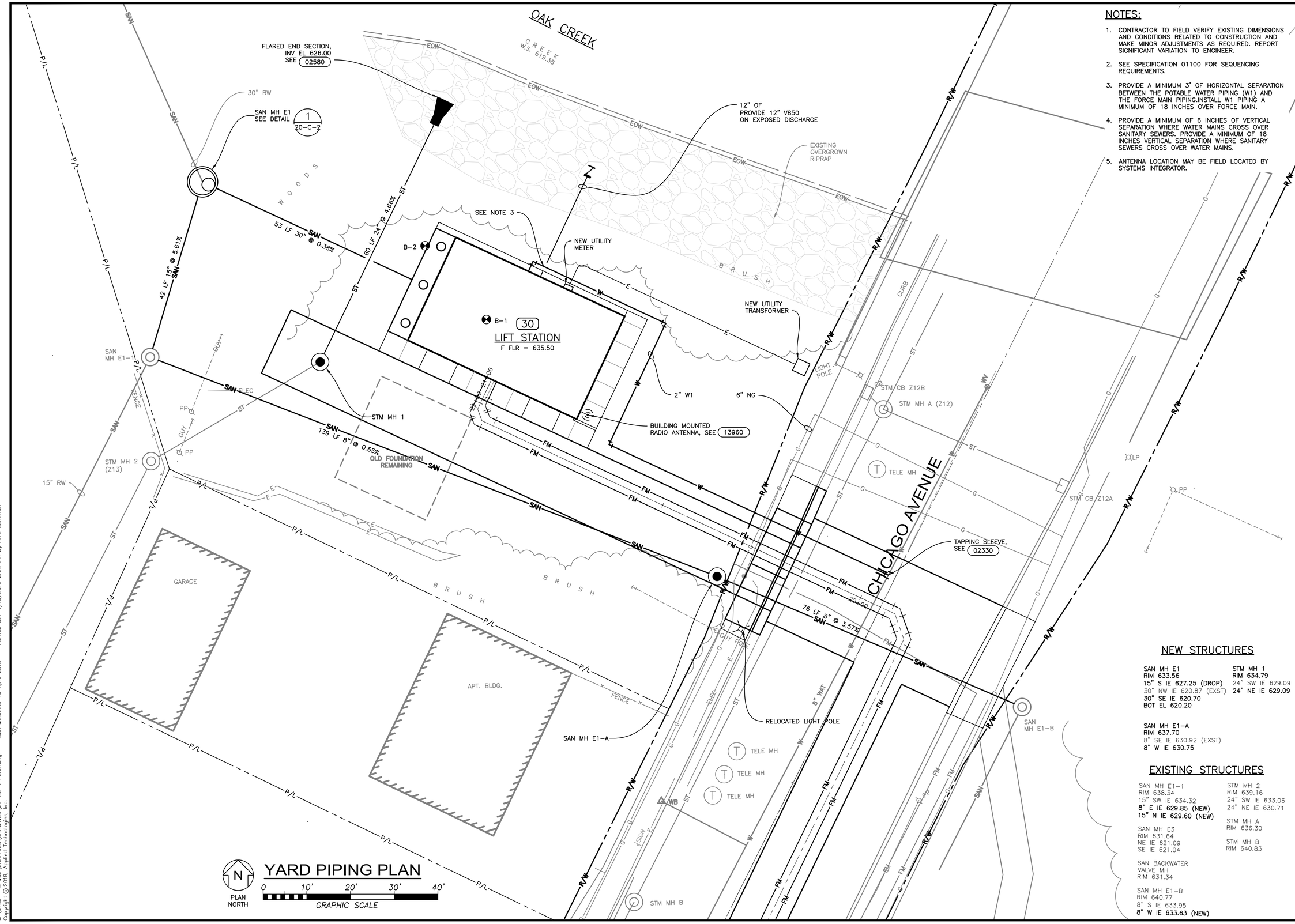
YARD PIPING PLAN



NOTES:

1. CONTRACTOR TO FIELD VERIFY EXISTING DIMENSIONS AND CONDITIONS RELATED TO CONSTRUCTION AND MAKE MINOR ADJUSTMENTS AS REQUIRED. REPORT SIGNIFICANT VARIATION TO ENGINEER.
2. SEE SPECIFICATION 01100 FOR SEQUENCING REQUIREMENTS.
3. PROVIDE A MINIMUM 3' OF HORIZONTAL SEPARATION BETWEEN THE POTABLE WATER PIPING (W1) AND THE FORCE MAIN PIPING.INSTALL W1 PIPING A MINIMUM OF 18 INCHES OVER FORCE MAIN.
4. PROVIDE A MINIMUM OF 6 INCHES OF VERTICAL SEPARATION WHERE WATER MAINS CROSS OVER SANITARY SEWERS. PROVIDE A MINIMUM OF 18 INCHES VERTICAL SEPARATION WHERE SANITARY SEWERS CROSS OVER WATER MAINS.
5. ANTENNA LOCATION MAY BE FIELD LOCATED BY SYSTEMS INTEGRATOR.

NEW STRUCTURES

SAN MH E1
RIM 633.56
15" S IE 627.25 (DROP)
30" NW IE 620.87 (EXST)
30" SE IE 620.70
BOT EL 620.20

SAN MH E1-A
RIM 637.70
8" SE IE 630.92 (EXST)
8" W IE 630.75

STM MH 1
RIM 634.79
24" SW IE 629.09
24" NE IE 629.09

EXISTING STRUCTURES

SAN MH E1-1
RIM 638.34
15" SW IE 634.32
8" E IE 629.85 (NEW)
15" N IE 629.60 (NEW)

SAN MH E3
RIM 631.64
NE IE 621.09
SE IE 621.04

SAN BACKWATER VALVE MH
RIM 631.34

SAN MH E1-B
RIM 640.77
8" S IE 633.95
8" W IE 633.63 (NEW)

STM MH 2
RIM 639.16
24" SW IE 633.06
24" NE IE 630.71

STM MH A
RIM 636.30

STM MH B
RIM 640.83

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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SITE WORK MECHANICAL/ELECTRICAL PLAN

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: P.C.G./J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 20-ME-1

PSLTSCALE: 1 LTSCALE: 1
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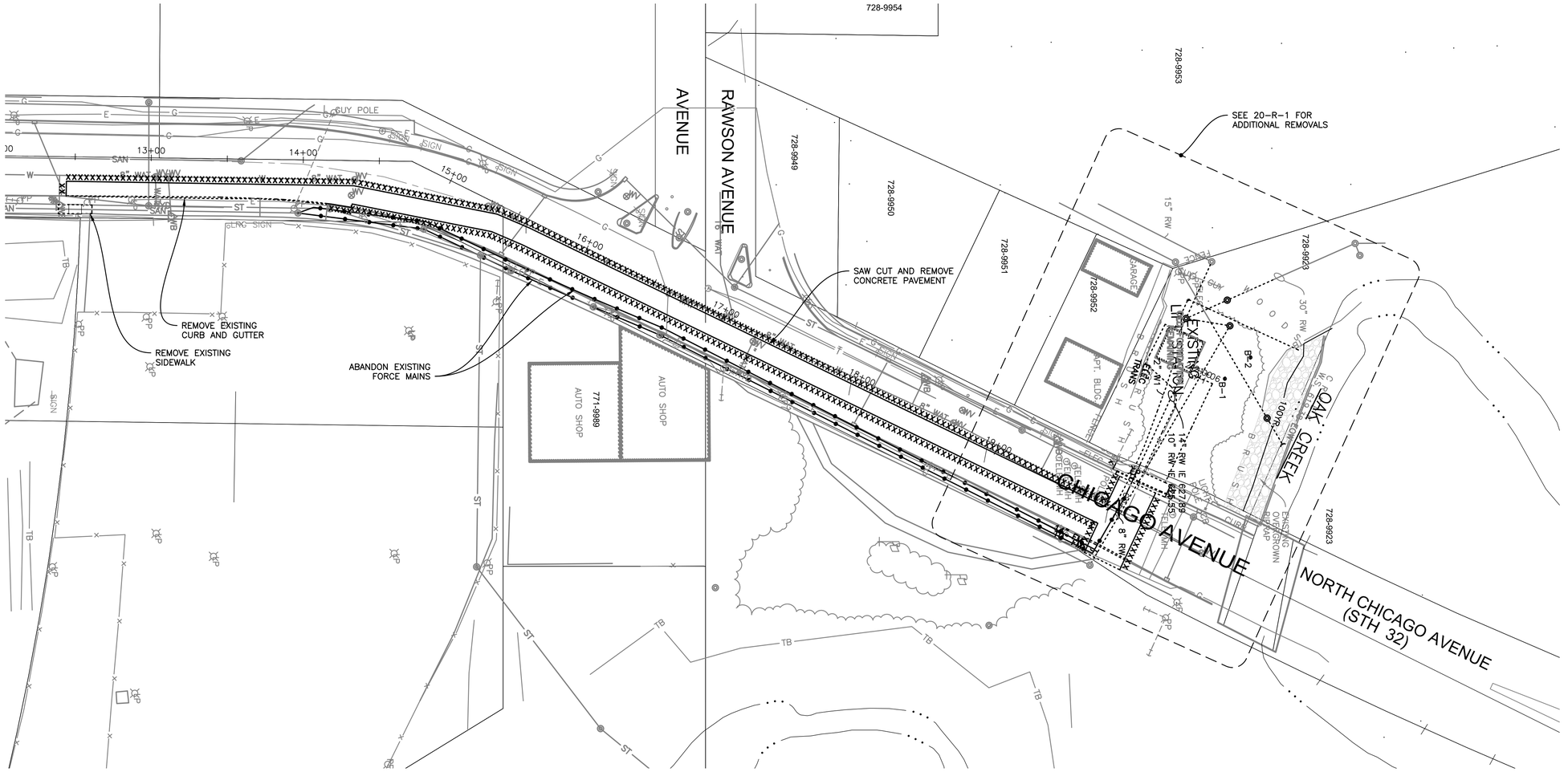

REMOVAL PLAN

NOTES:

1. ABANDON THE 10" AND 14" FORCE MAINS BY FILLING EACH PIPE WITH ELASTIZELL CELLULAR CONCRETE (TYPE PS 120) OR EQUAL.
2. SAW CUT AND REMOVE EXISTING PAVEMENT. REMOVE PAVEMENT TO NEAREST JOINT AS FOLLOWS:
   - 2.1. STA 12+50 TO STA 14+50 NORTHBOUND CURB LANE
   - 2.2. STA 14+50 TO STA 15+50 NORTHBOUND CURB AND TRAFFIC LANES
   - 2.3. STA 15+50 TO STA 20+00 NORTHBOUND TRAFFIC LANE.
3. CURB AND PAVEMENT REMOVAL IS TO BEGIN AND END AT AN EXISTING JOINT IN THE CONCRETE WORK.
4. BLIND FLANGE, CAP OR PLUG ALL ABANDONED PIPING.
5. ALL CONSTRUCTION SHALL COMPLY WITH THE STANDARD SPECIFICATIONS FOR HIGHWAY AND STRUCTURE CONSTRUCTION IN WISCONSIN, CURRENT EDITION.
6. SCHEDULE DEMOLITION AND TEMPORARY FACILITIES WITH OWNER AND ENGINEER.
7. CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL PLAN IN ACCORDANCE WITH SECTION 01500.

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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

DUAL FORCE MAINS
REMOVAL
PLAN

VERIFY SCALES
LENGTH OF BAR IS 1"
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1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY:	K.R.H.
DRAWN BY:	P.C.G.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	25-R-1

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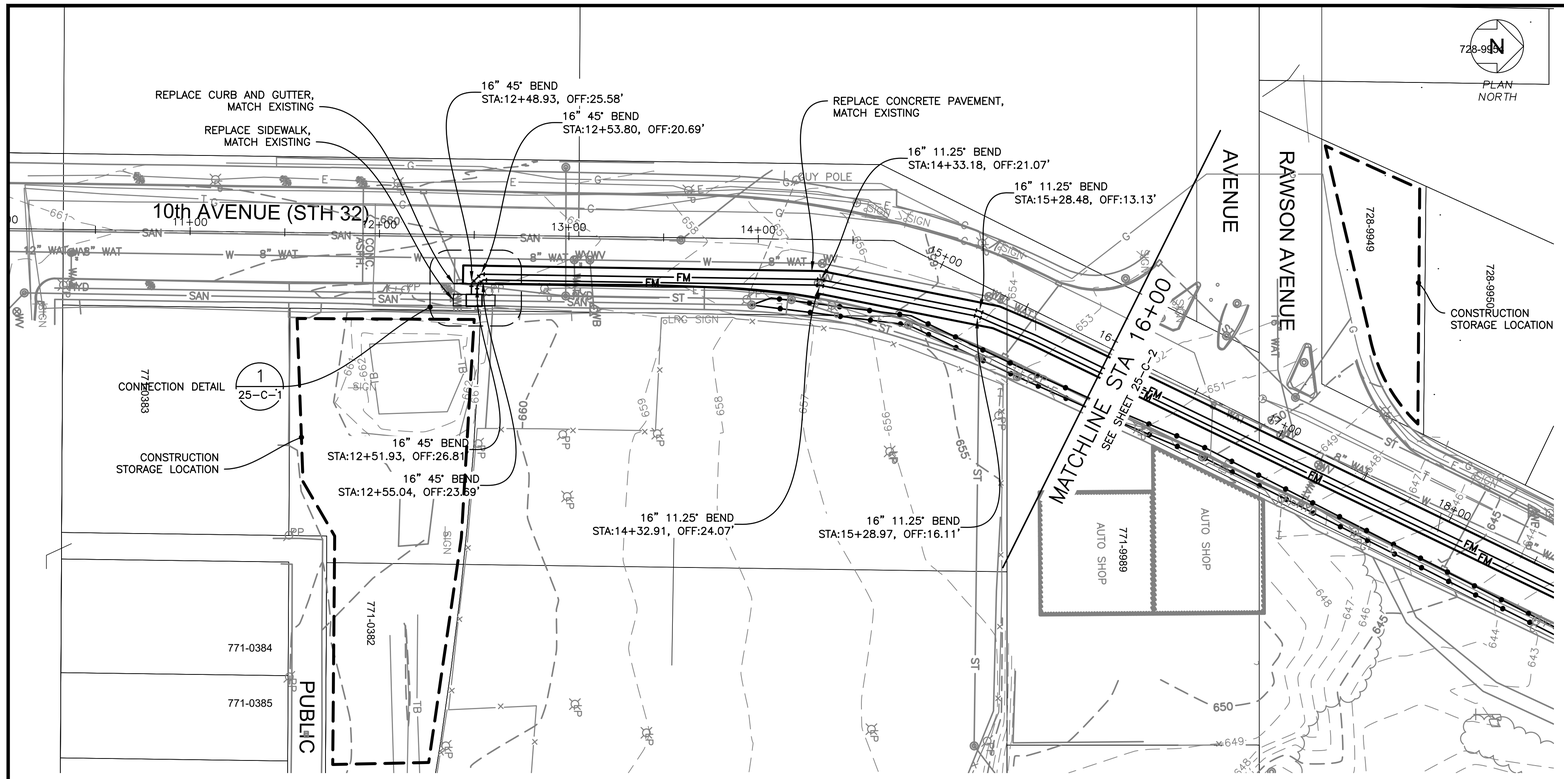

GENERAL NOTES:

1. COMPLY WITH SDD 15D28–3 FOR LANE CLOSURE AND WORK ZONE TRAFFIC CONTROL.
2. FORCE MAINS SHALL BE INSTALLED WITH 3 FEET OF SEPARATION BETWEEN PIPE CENTERLINES.
3. SAWCUT AND REMOVE EXISTING PAVEMENT. REMOVE PAVEMENT TO NEAREST JOINT AS FOLLOWS:
   3.1. STA 12+50 TO STA 14+50 NORTHBOUND CURB LANE
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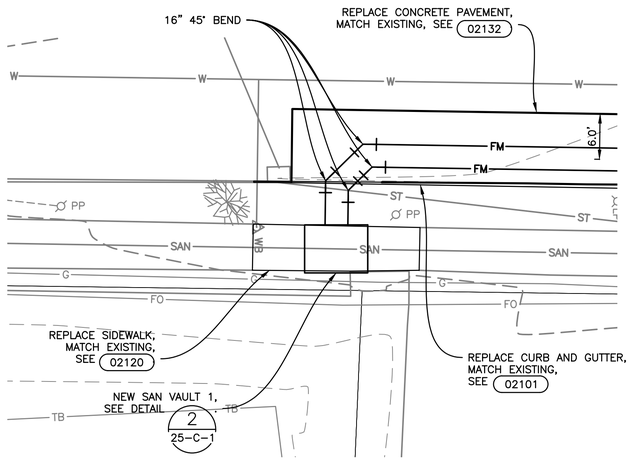
   3.3. STA 15+50 TO STA 20+00 NORTHBOUND TRAFFIC LANE.
4. CONTRACTOR SHALL FURNISH AND INSTALL DRILLED DOWEL BARS TO TIE NEW TO EXISTING PAVEMENT AND CURB AND GUTTER IN ACCORDANCE WITH SDD 13C9–14C.
5. REPLACEMENT PAVEMENT SHALL BE 9 INCHES THICK WITH A 6 INCH THICK CRUSHED AGGREGATE BASE COURSE CONSTRUCTED WITH HES CONCRETE IN ACCORDANCE WITH SECTION 415 OF THE D.O.T. SPECIFICATIONS.
6. BEDDING/COVER MATERIAL SHALL CONFORM TO SECTION 02320 2.1.
7. BACKFILL MATERIAL SHALL BE MECHANICALLY COMPACTED GRANULAR BACKFILL CONFORMING TO SECTION 02320 2.1.
8. CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL PLAN IN ACCORDANCE WITH SECTION 01500.

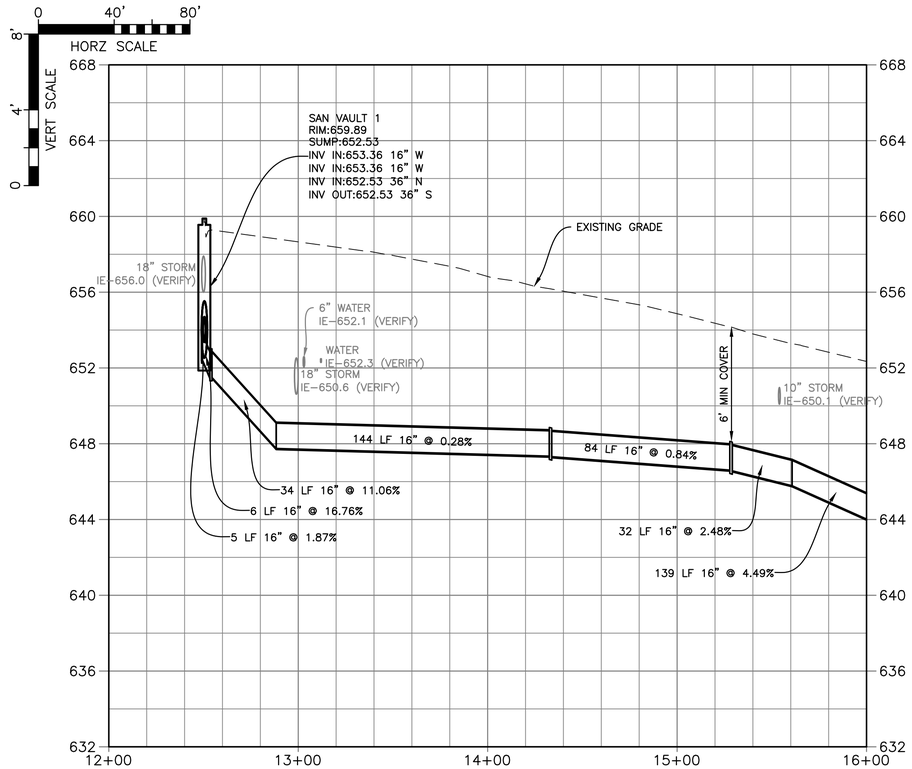


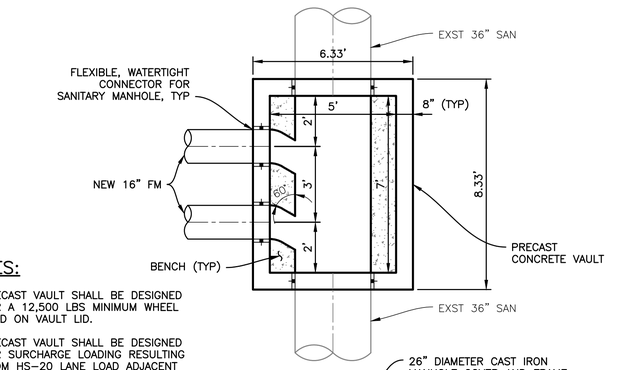
1 CONNECTION DETAIL
25-C-1 1" = 10'

EXISTING STRUCTURES:

SAN MH A34
RIM–660.53
36"N IE–652.18
36"SE IE–652.02

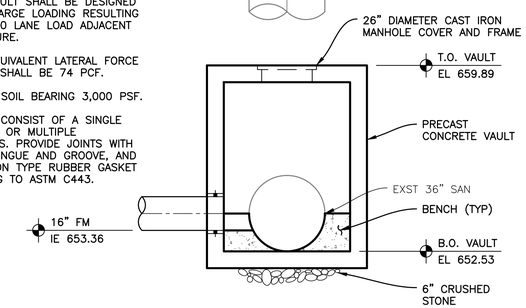
SAN MH A35
RIM–657.41
10"NW IE–653.60
14"N IE–653.61
36"S IE–652.75





NOTES:

1. PRECAST VAULT SHALL BE DESIGNED FOR A 12,500 LBS MINIMUM WHEEL LOAD ON VAULT LID.
2. PRECAST VAULT SHALL BE DESIGNED FOR SURCHARGE LOADING RESULTING FROM HS–20 LANE LOAD ADJACENT TO STRUCTURE.
3. MINIMUM EQUIVALENT LATERAL FORCE FROM SOIL SHALL BE 74 PCF.
4. ALLOWABLE SOIL BEARING 3,000 PSF.
5. VAULT MAY CONSIST OF A SINGLE COMPONENT OR MULTIPLE COMPONENTS. PROVIDE JOINTS WITH PRECAST TONGUE AND GROOVE, AND COMPRESSION TYPE RUBBER GASKET CONFORMING TO ASTM C443.



2 SANITARY VAULT 1
25-C-1 1" = 3'

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NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

DUAL FORCE MAINS
CIVIL
PLAN & PROFILE

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H./P.C.G.
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 25-C-1

PSLTSCALE: 1 LTSCALE: 1
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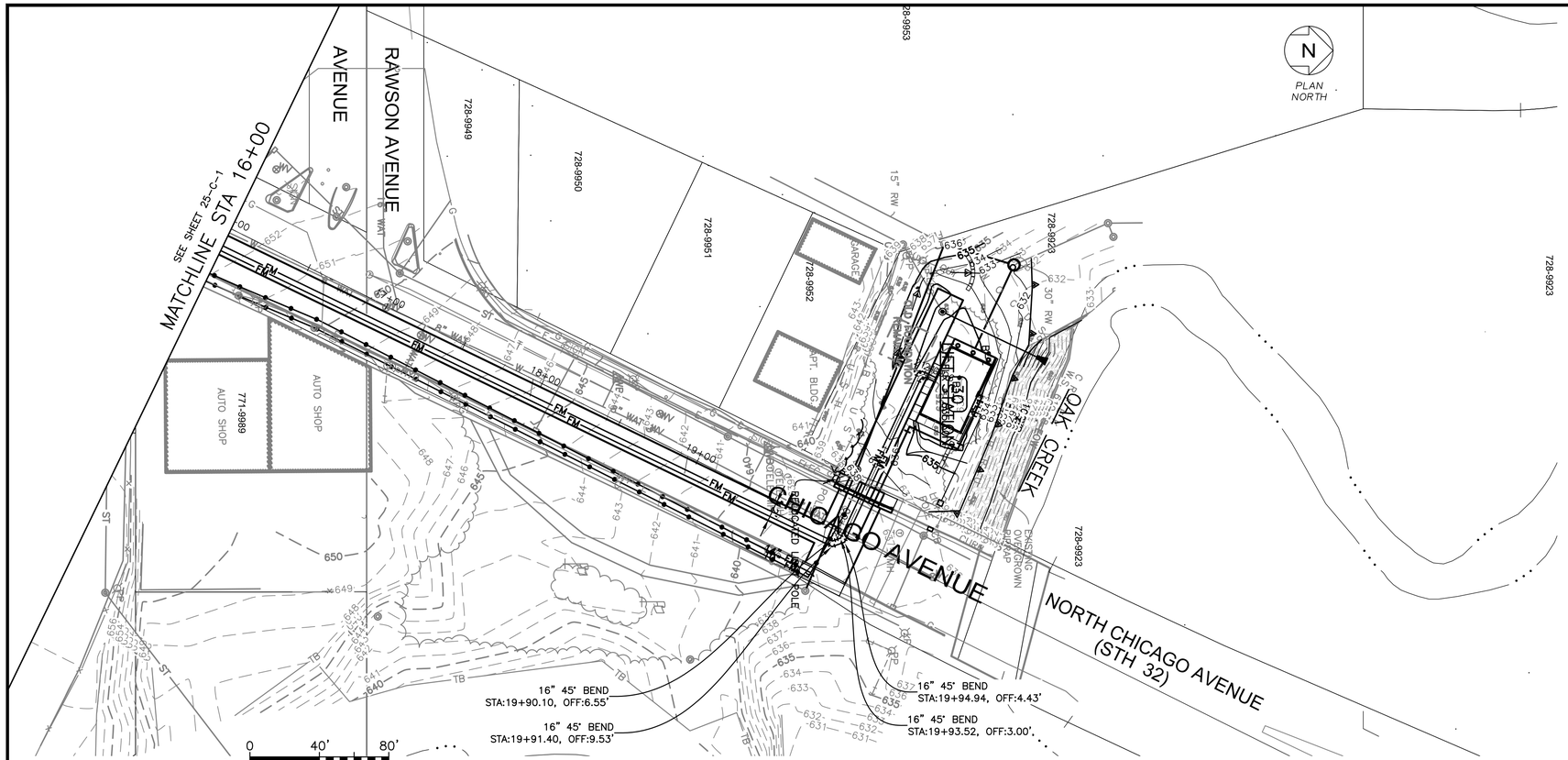

GENERAL NOTES:

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NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

DUAL FORCE MAINS
CIVIL
PLAN & PROFILE

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	K.R.H./P.C.G.
DRAWN BY:	P.C.G.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	25-C-2

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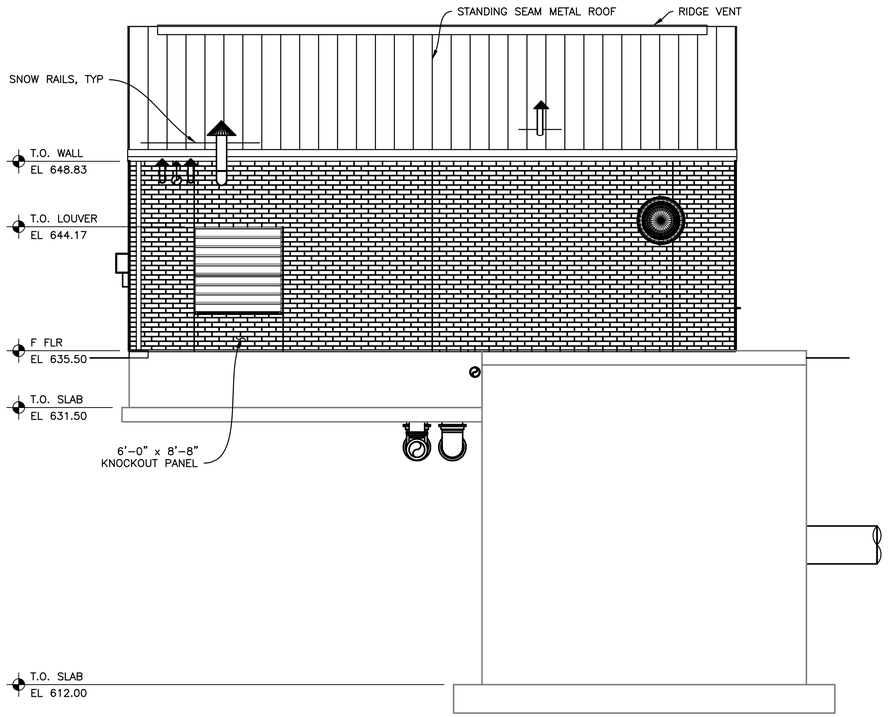
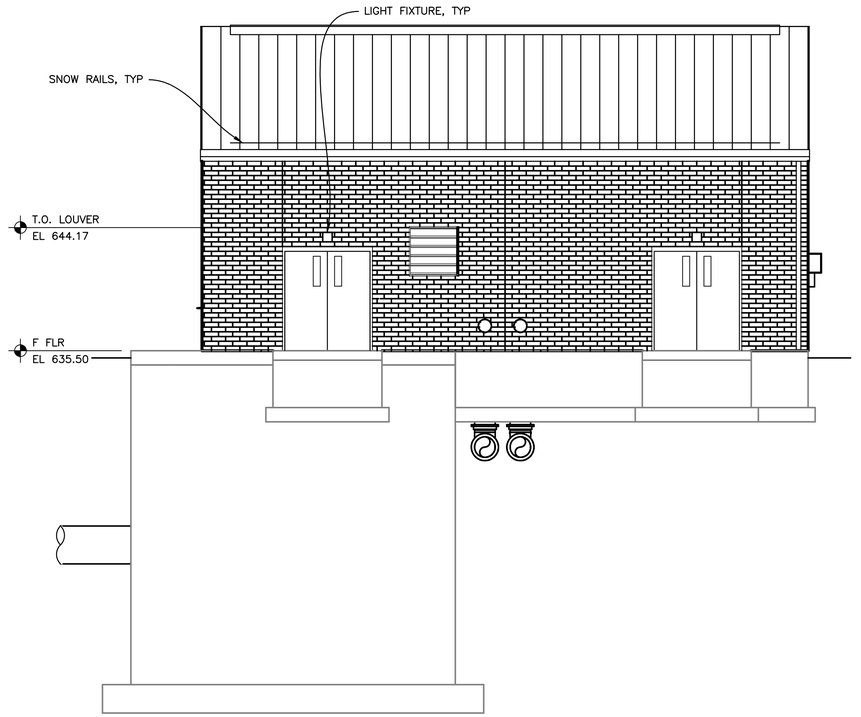
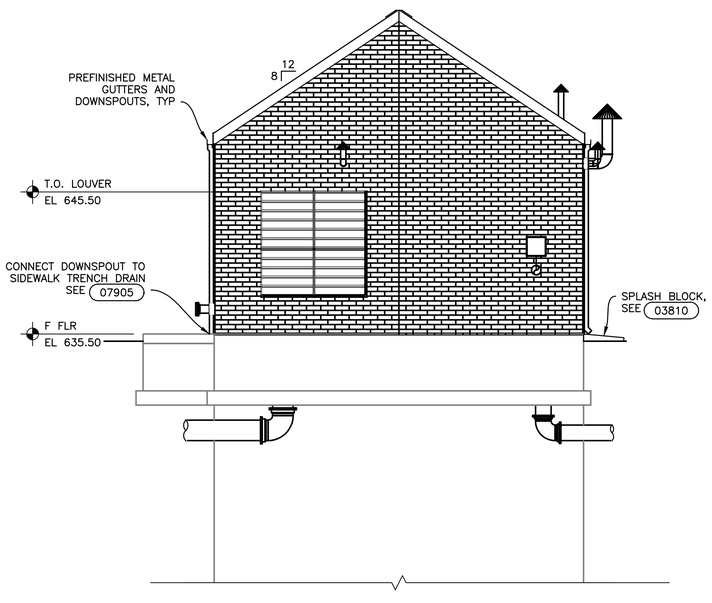


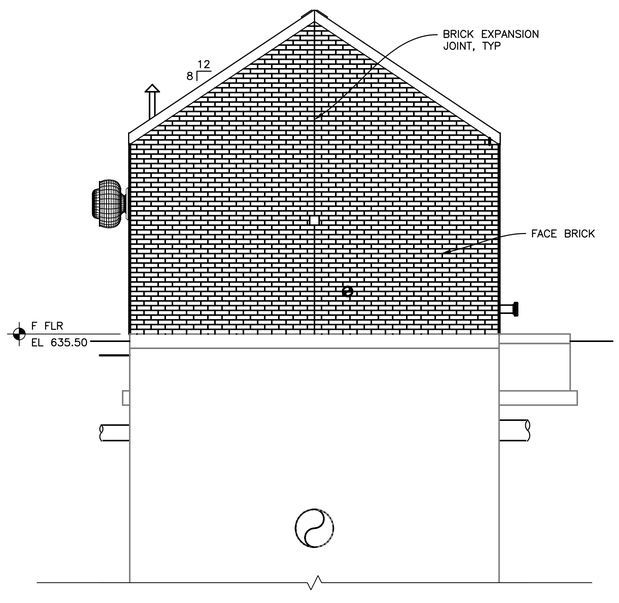
1 NORTH ELEVATION
30-AS-2 3/16" = 1'-0"



2 SOUTH ELEVATION
30-AS-2 3/16" = 1'-0"



3 EAST ELEVATION
30-AS-2 3/16" = 1'-0"



4 WEST ELEVATION
30-AS-2 3/16" = 1'-0"

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CITY OF SOUTH MILWAUKEE
N. CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION
ARCHITECTURAL
ELEVATIONS

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: J.P.G./B.A.G.
DRAWN BY: J.T.H.
CHECKED BY: .
APPROVED BY: .
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 30-A-1

PSLTSCALE: 1 LTSCALE: 1
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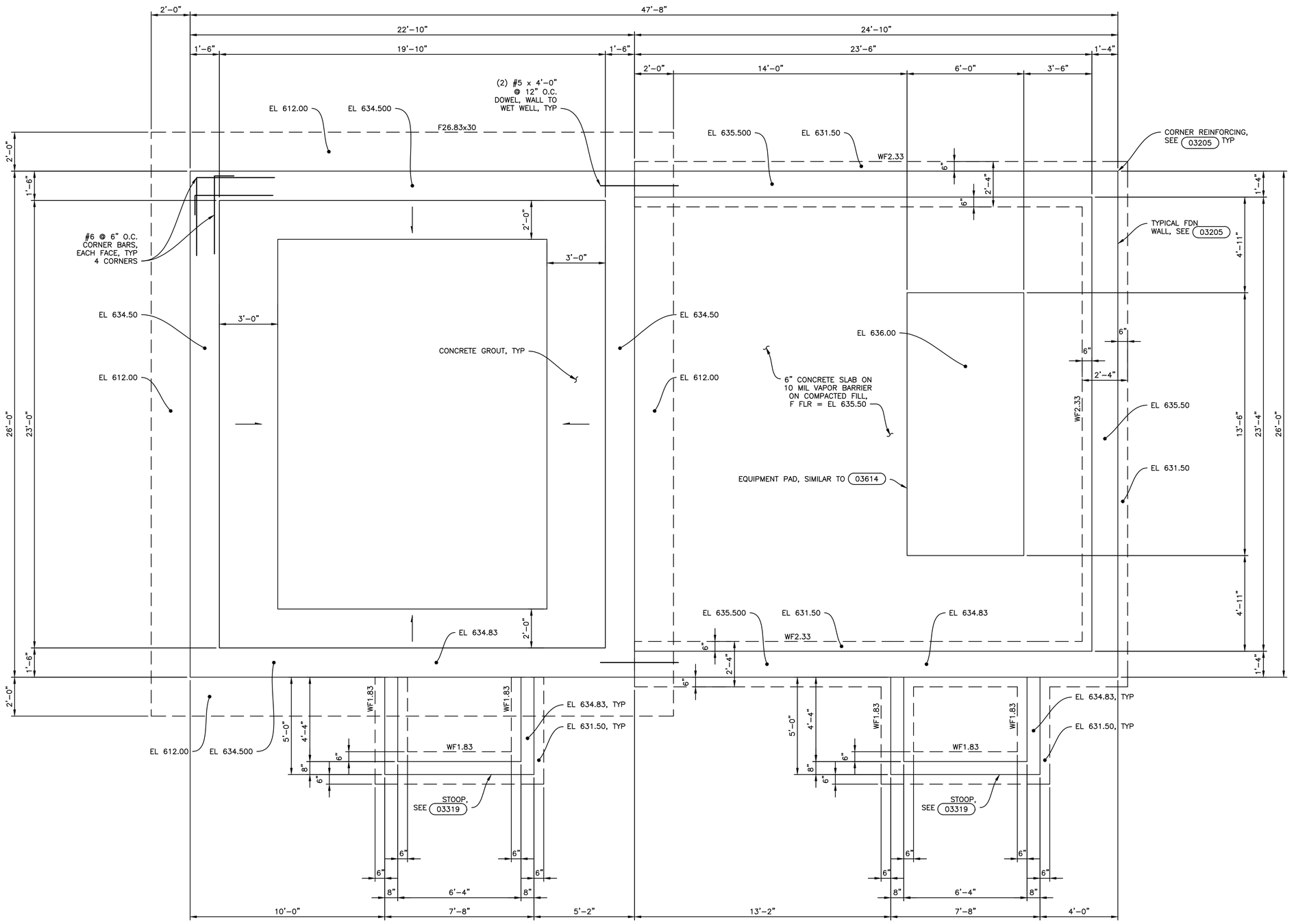

N
PLAN NORTH

FOUNDATION PLAN

3/8" = 1'-0"

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N. CHICAGO LIFT STATION
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SOUTH MILWAUKEE, WI

LIFT STATION
ARCHITECTURAL/STRUCTURAL
PLAN

VERIFY SCALES
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1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

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APPROVED BY:	.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	30-AS-1

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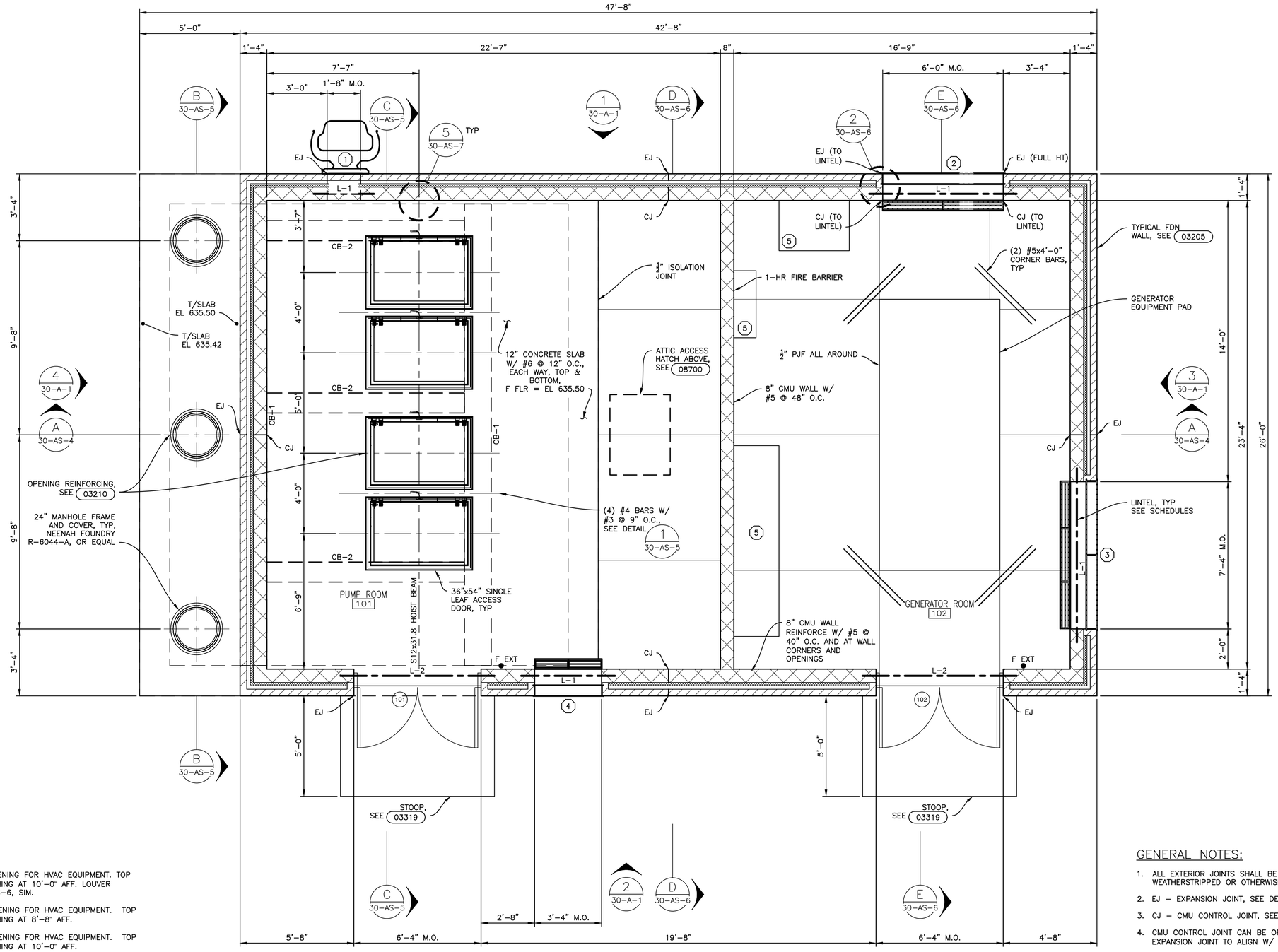

KEYED NOTES:

1. 1'-8" X 1'-8" OPENING FOR HVAC EQUIPMENT. TOP OF MASONRY OPENING AT 10'-0" AFF. LOUVER DETAILS ON 30-AS-6, SIM.
2. 6'-0" X 6'-0" OPENING FOR HVAC EQUIPMENT. TOP OF MASONRY OPENING AT 8'-8" AFF.
3. 7'-4" X 7'-4" OPENING FOR HVAC EQUIPMENT. TOP OF MASONRY OPENING AT 10'-0" AFF.
4. 3'-4" X 3'-4" OPENING FOR HVAC EQUIPMENT. TOP OF MASONRY OPENING AT 8'-8" AFF.
5. EQUIPMENT PAD, SEE 03617 .

GENERAL NOTES:

1. ALL EXTERIOR JOINTS SHALL BE CAULKED, GASKETED, WEATHERSTRIPPED OR OTHERWISE SEALED.
2. EJ – EXPANSION JOINT, SEE DETAIL 04010
3. CJ – CMU CONTROL JOINT, SEE DETAIL 04010
4. CMU CONTROL JOINT CAN BE OFFSET FROM BRICK EXPANSION JOINT TO ALIGN W/ MASONRY JOINTS.
5. ALL CONTROL JOINTS, HEAD OF WALL, AND WALL TO WALL JOINTS IN FIRE RATED WALLS SHALL BE FIRESTOPPED TO MAINTAIN FIRE RATING.
6. LOCATION OF ATTIC ACCESS HATCH IS APPROXIMATE. CONTRACTOR TO VERIFY LOCATION WITH TRUSS LAYOUT.
7. ALL SIMPSON CONNECTORS IDENTIFIED ON DRAWINGS SHALL HAVE FASTENERS AS REQUIRED BY CURRENT SIMPSON CATALOG.

N
PLAN NORTH

FLOOR PLAN
3/8" = 1'-0"

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CITY OF SOUTH MILWAUKEE
N. CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION
ARCHITECTURAL/STRUCTURAL
PLAN

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	J.P.G./B.A.G.
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CHECKED BY:	.
APPROVED BY:	.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	30-AS-2

PSLTSCALE: 1 LTSCALE: 1
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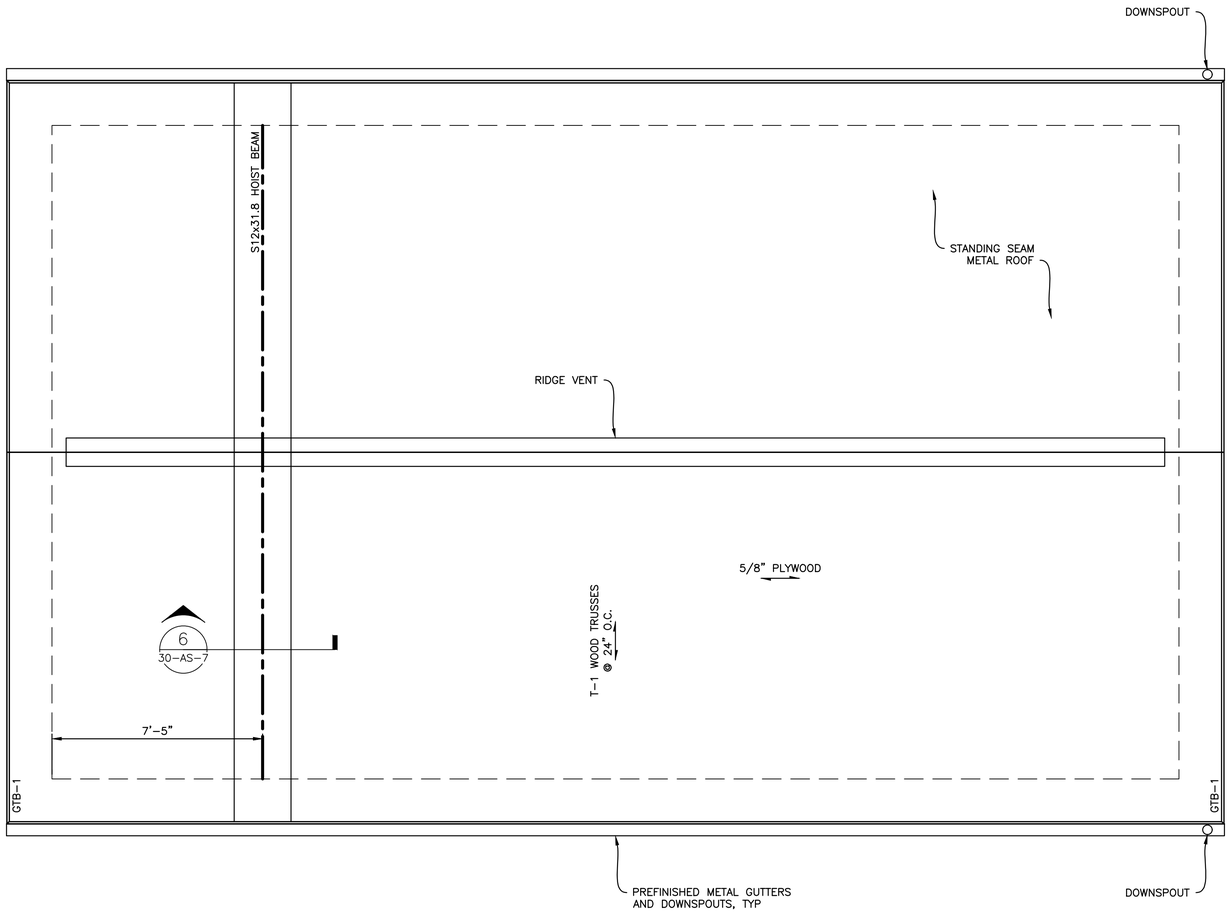


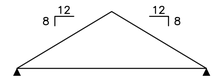
N
PLAN
NORTH

ROOF PLAN
3/8" = 1'-0"

GENERAL NOTES:

1. PROVIDE ATTIC VENTILATION OF MINIMUM 534 SQ IN. NFA AT EAVE AND 534 SQ IN. NFA AT RIDGE VENT. NFA AT RIDGE VENT SHALL NOT EXCEED NFA AT SOFFIT.
2. TRUSS SUPPLIER TO VERIFY ANY HANGING MECHANICAL EQUIPMENT AND PIPING FOR HANGER DETAIL SEE (15156).
3. FOR ROOF PENETRATIONS SEE DETAIL (07616).

TRUSS PROFILE SCHEDULE



T-1

GTB-1

TRUSS PROFILE NOTES:

1. TRUSS MANUFACTURER SHALL VERIFY TRUSS SLOPES WITH ROOF PLAN.
2. ALL TRUSS TO TRUSS CONNECTIONS TO BE DESIGNED BY TRUSS SUPPLIER.
3. GIRDERS TRUSS PROFILES SHALL MATCH TRUSS PROFILES.
4. COORDINATE EAVE OVERHANG WITH SECTIONS AND PLANS.
5. TRUSS TO STRUCTURE CONNECTION SHALL BE HETAL 16 SIMPSON METAL TRUSS ANCHORS. PROVIDE EQUAL NUMBER OF 10d NAILS TO MATCH TRUSS ANCHOR REQUIRED FASTENERS.
6. TRUSS PROVIDER MAY PROVIDE ALTERNATE ANCHOR CONNECTION WITH EQUAL OR GREATER UPLIFT CAPACITY AND LATERAL RESISTANCE FOR APPROVAL BY THE ENGINEER.
7. PROVIDE VERTICAL MEMBERS AT GABLE END TRUSSES AT 24" MAXIMUM SPACING.
8. DESIGN ROOF TRUSSES FOR THE FOLLOWING LOADS:
   TOP CHORD LIVE LOAD: 20 PSF
   TOP CHORD DEAD LOAD: 10 PSF
   BOTTOM CHORD LIVE LOAD: 5 PSF
   BOTTOM CHORD DEAD LOAD: 10 PSF

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CITY OF SOUTH MILWAUKEE
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IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION
ARCHITECTURAL/STRUCTURAL
PLAN

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: J.P.G./B.A.G.
DRAWN BY: J.T.H.
CHECKED BY: .
APPROVED BY: .
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 30-AS-3

PSLTSCALE: 1 LTSCALE: 1
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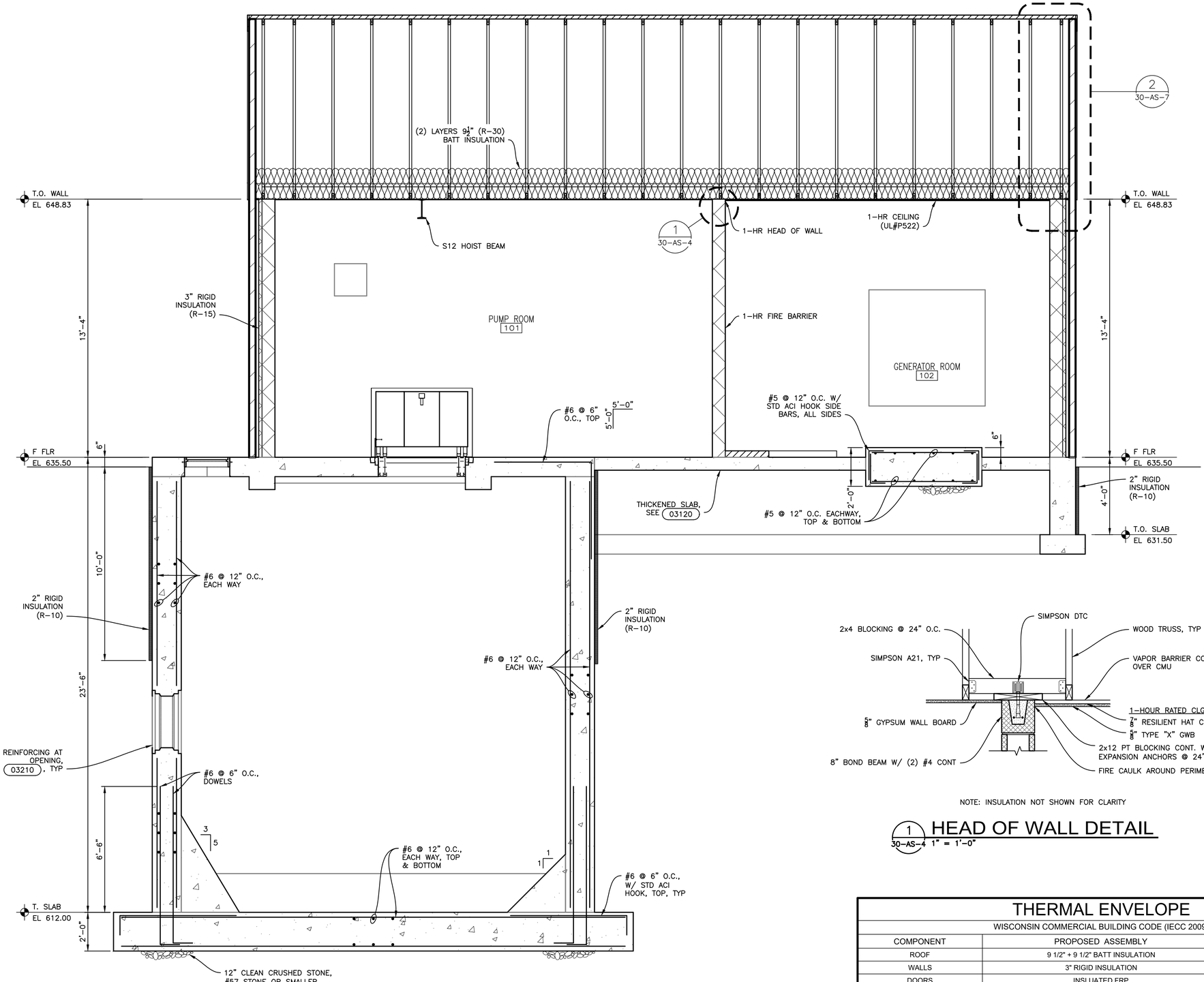
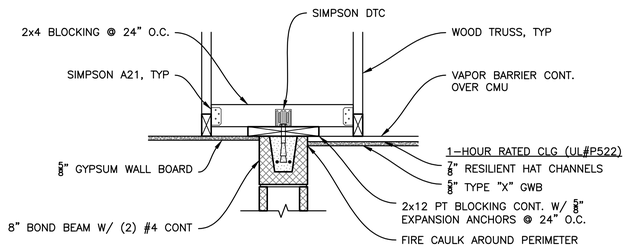


A 30–AS–2 **SECTION A** 3/8" = 1'–0"



NOTE: INSULATION NOT SHOWN FOR CLARITY

1 30–AS–4 **HEAD OF WALL DETAIL** 1" = 1'–0"

THERMAL ENVELOPE

WISCONSIN COMMERCIAL BUILDING CODE (IECC 2009)

COMPONENT	PROPOSED ASSEMBLY	THERMAL VALUE
ROOF	9 1/2" + 9 1/2" BATT INSULATION	R-60S-301
WALLS	3" RIGID INSULATION	R-15
DOORS	INSLUATED FRP	U-0.35
LOUUVERS	INSULATED DAMPERS	U-0.44
SLAB	2" RIGID INSULATION	R-10
BELOW GRADE WALLS	2" RIGID INSULATION	R-10

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CITY OF SOUTH MILWAUKEE
N. CHICAGO LIFTSTATION IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION ARCHITECTURAL/STRUCTURAL SECTION

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: J.P.G./B.A.G.
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PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 30-AS-4

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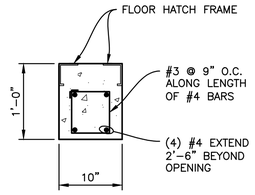
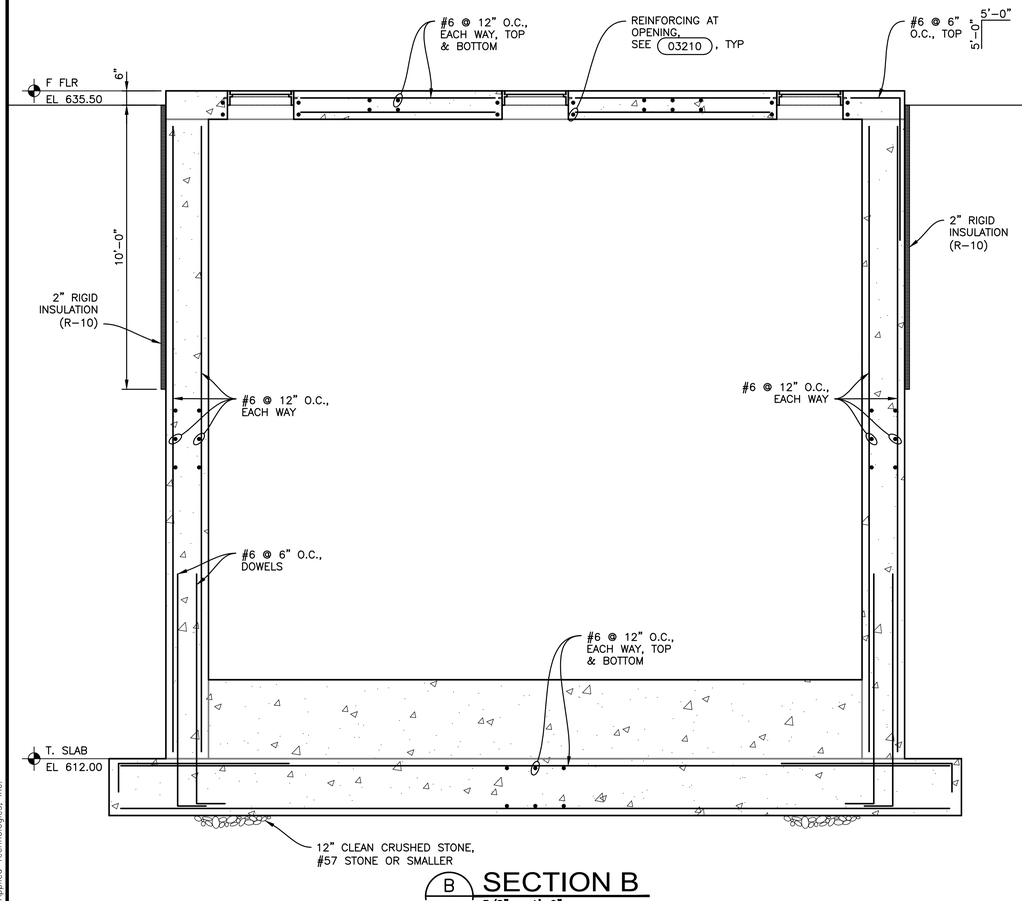
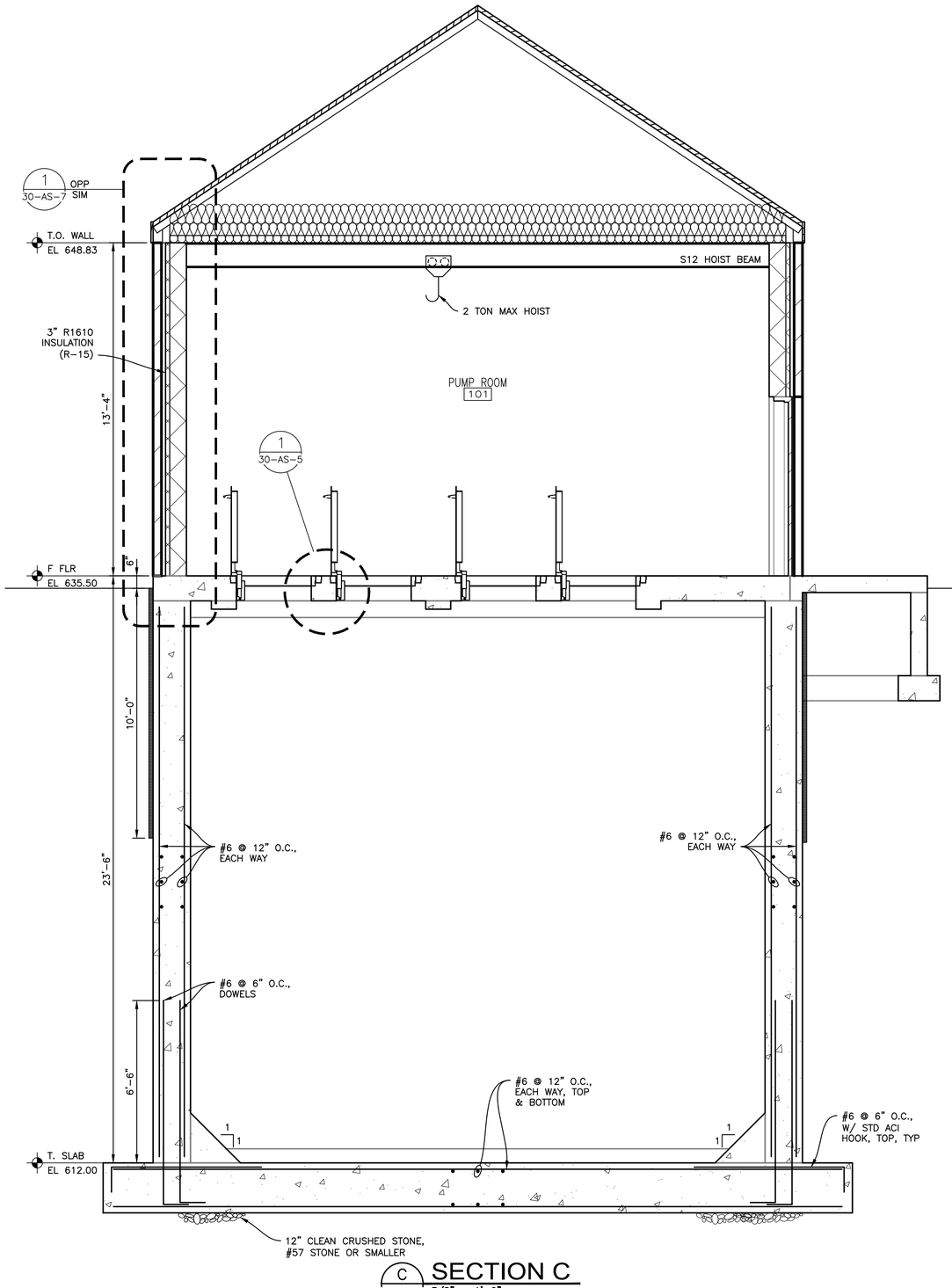


1 / 30-AS-5 HATCH FRAME REINFORCING
1" = 1'-0"



B / 30-AS-2 SECTION B
3/8" = 1'-0"



C / 30-AS-2 SECTION C
3/8" = 1'-0"

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IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION
ARCHITECTURAL/STRUCTURAL
SECTIONS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

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DRAWN BY: J.T.H.
CHECKED BY: .
APPROVED BY: .
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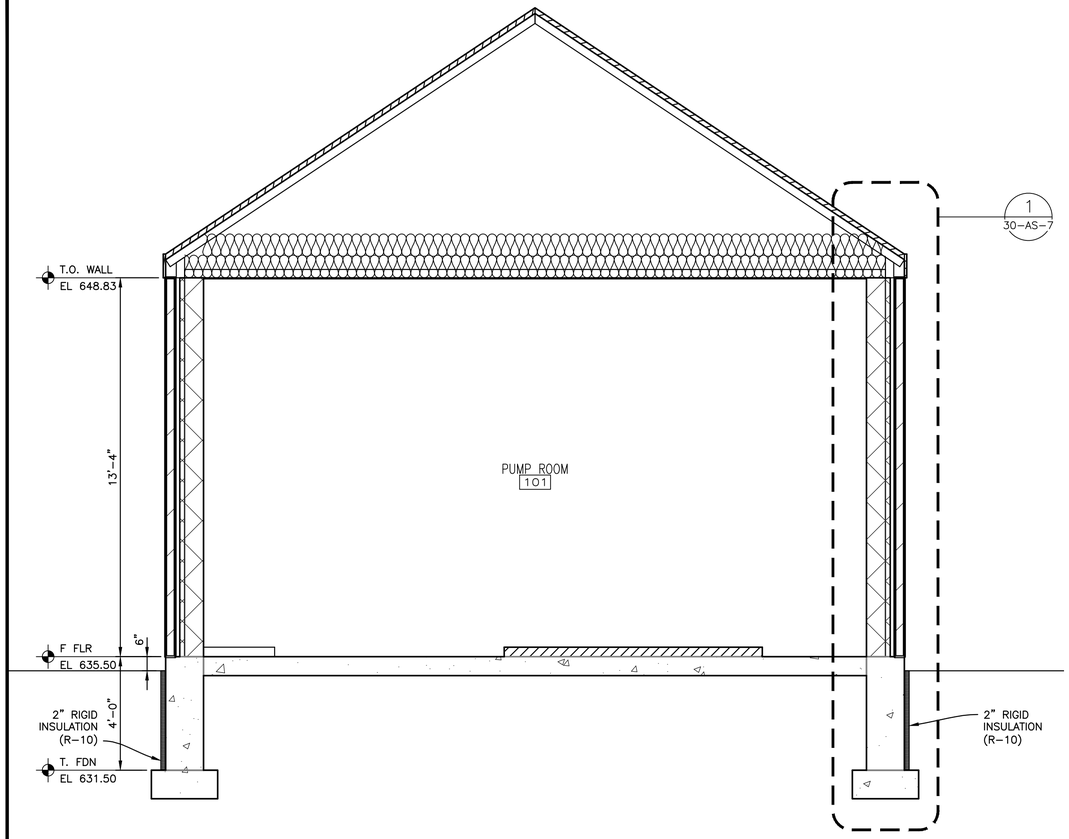
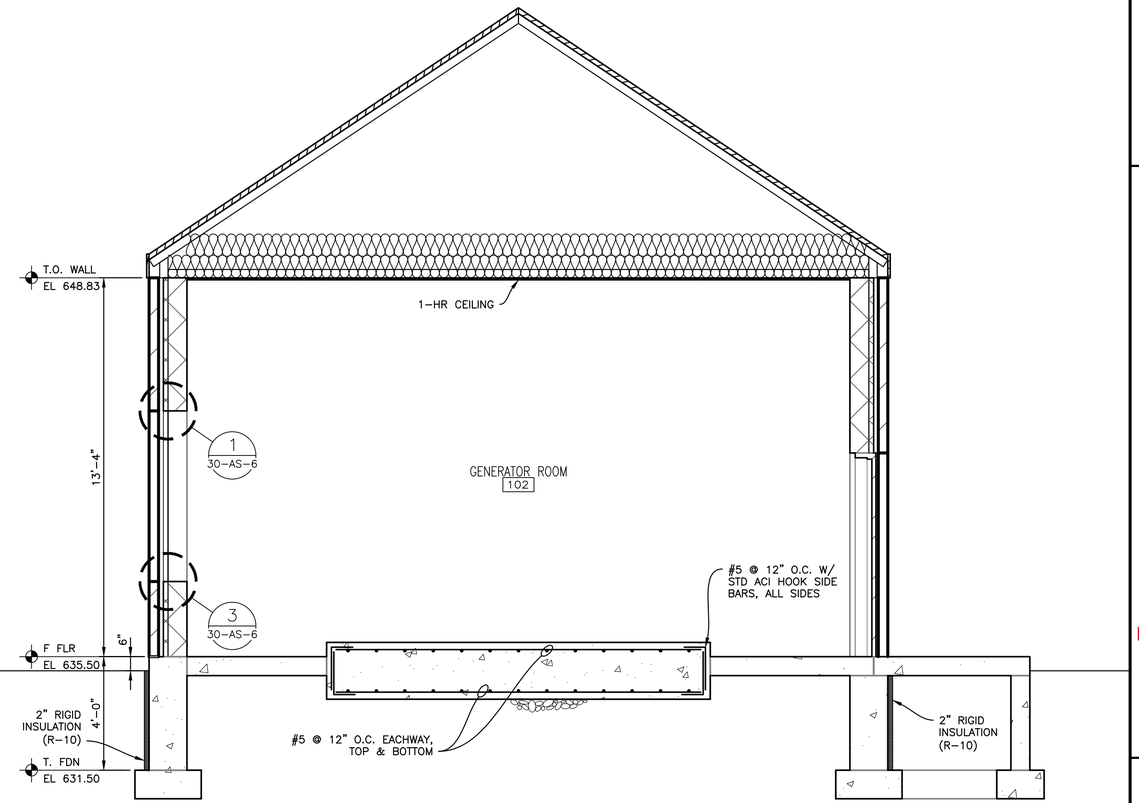
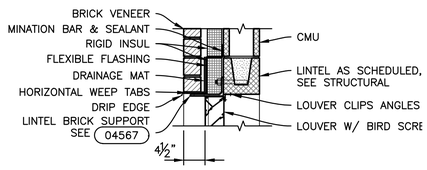


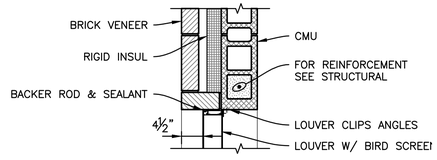
D SECTION D
30-AS-2 3/8" = 1'-0"



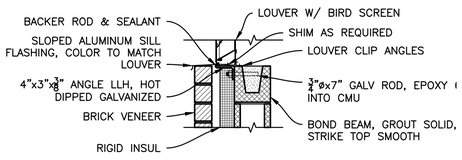
E SECTION E
30-AS-2 3/8" = 1'-0"



1 LOUVER HEAD DETAIL
30-AS-6 3/4" = 1'-0"



2 LOUVER JAMB DETAIL
30-AS-2 3/4" = 1'-0"



3 LOUVER SILL DETAIL
30-AS-6 3/4" = 1'-0"

NOTES:

1. LOUVER DETAILS ARE TYPICAL FOR ALL LOUVERS.

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LIFT STATION
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SECTIONS

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1:1
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SCALE(S) ACCORDINGLY

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APPROVED BY:	.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	30-AS-6

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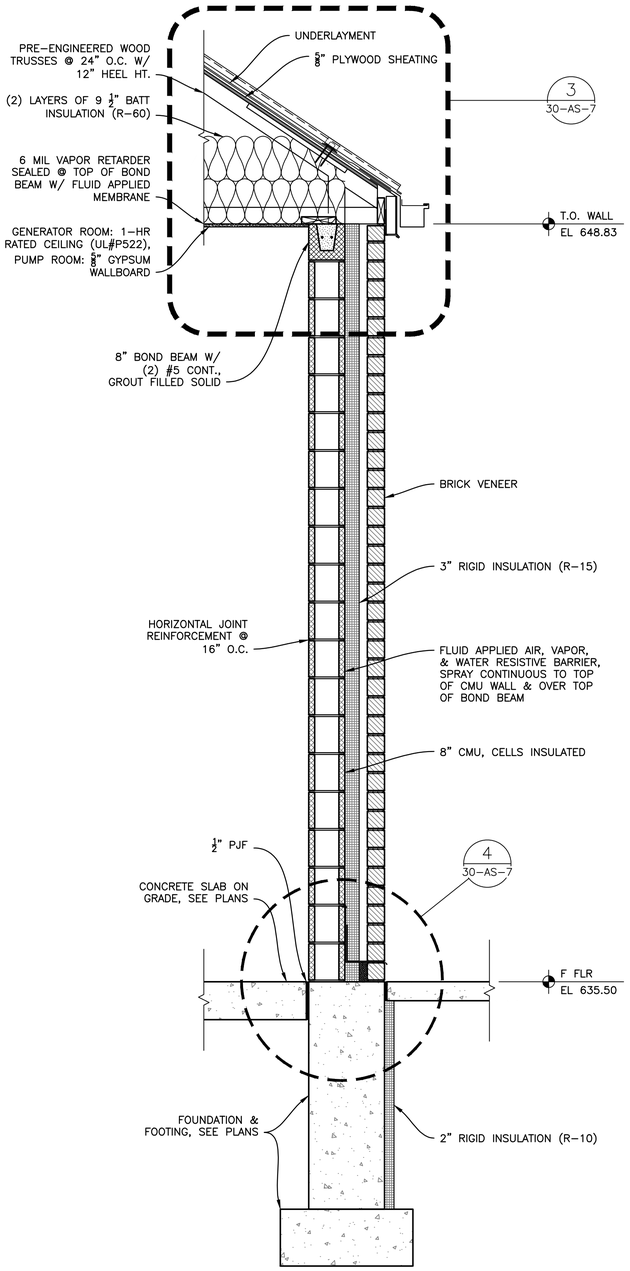
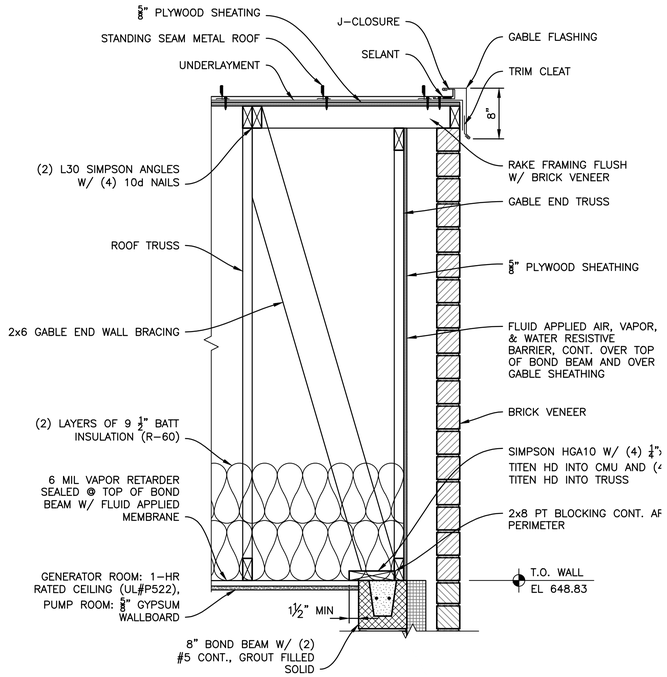
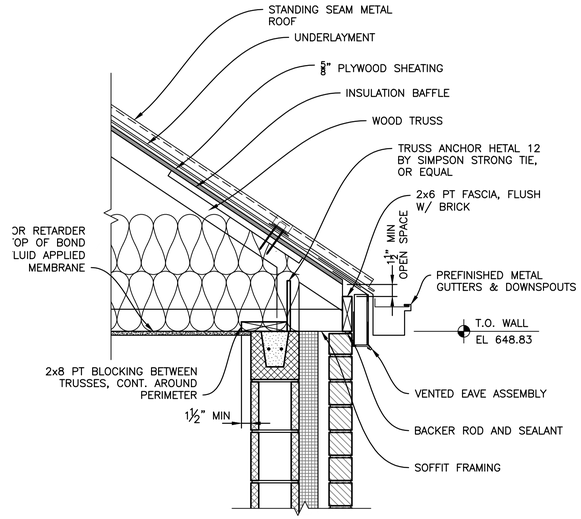


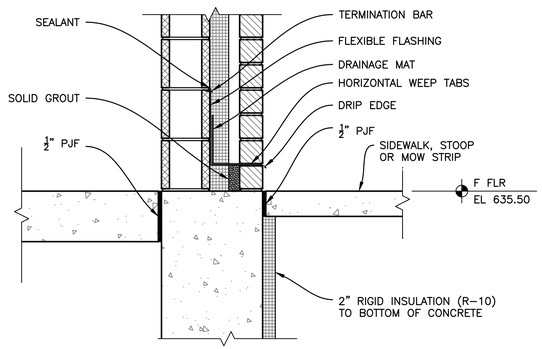
1 WALL SECTION
30-AS-5 3/4" = 1'-0"
30-AS-6



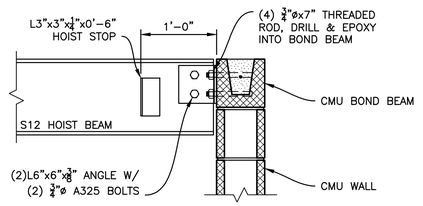
2 GABLE ROOF DETAIL
30-AS-4 1" = 1'-0"



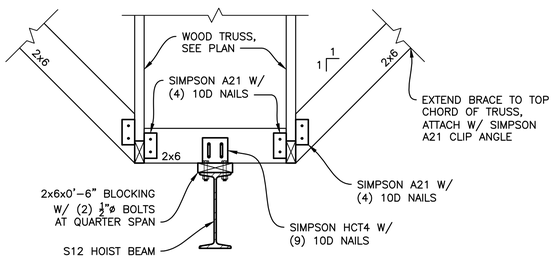
3 ROOF DETAIL
30-AS-7 1" = 1'-0"



4 BASE DETAIL
30-AS-7 1" = 1'-0"



5 HOIST BEAM ATTACHMENT
30-AS-2 1" = 1'-0"



NOTE:
HOIST BEAM BRACING REQUIRED AT 1/4 SPAN OR 8'-0" MAX WHICH EVER IS LESS. CUT BRACING TO FIT TIGHT.

6 HOIST BEAM SUPPORT
30-AS-3 1" = 1'-0"

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LIFT STATION
ARCHITECTURAL/STRUCTURAL
DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

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DRAWN BY:	J.T.H.
CHECKED BY:	.
APPROVED BY:	.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	30-AS-7

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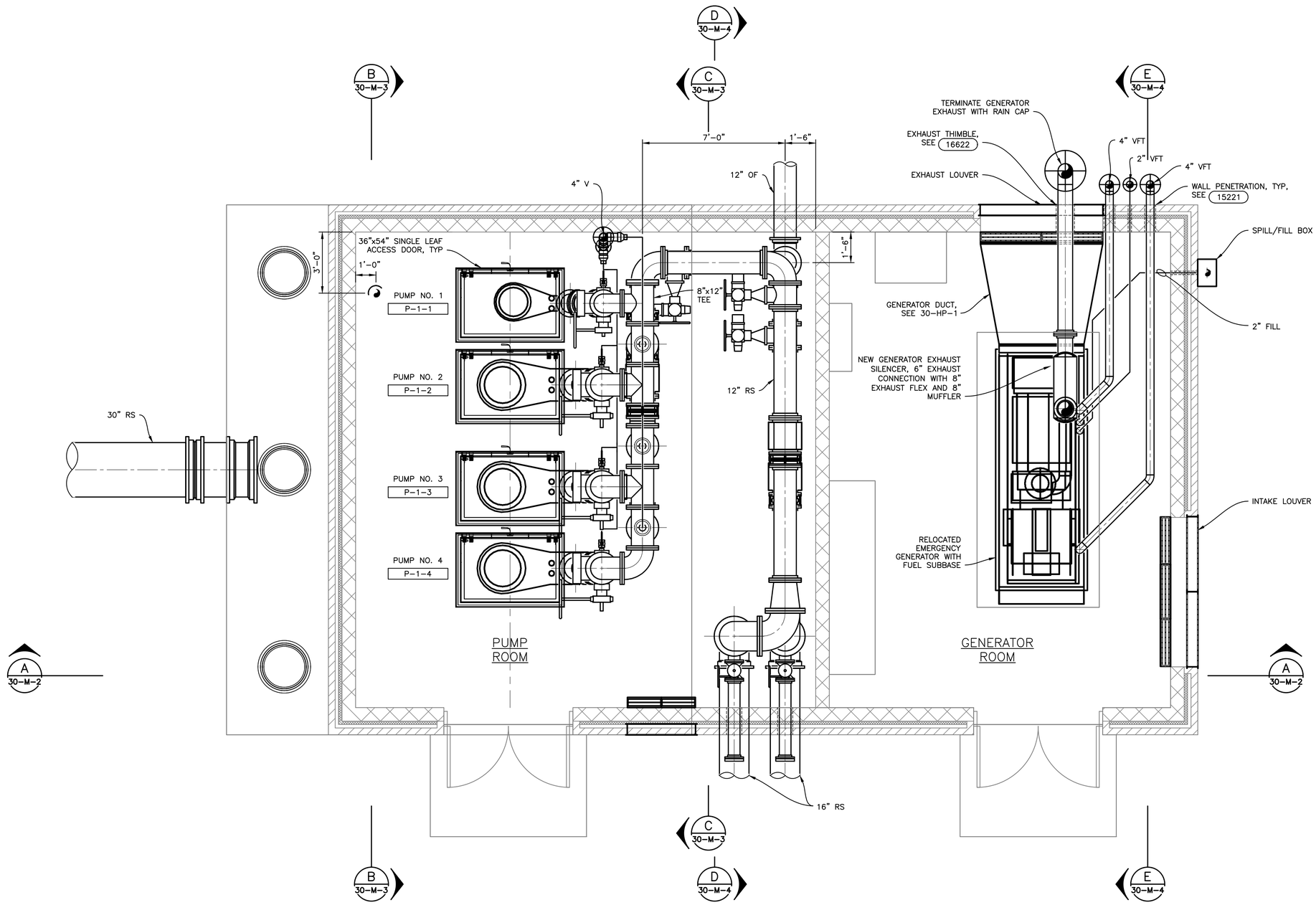

N
PLAN NORTH

PLAN
3/8" = 1'-0"

NOTES:

1. CONTRACTORS TO FIELD VERIFY ALL GENERATOR DIMENSIONS, PIPING CONNECTIONS AND CONDITIONS AND MAKE MINOR ADJUSTMENTS AS REQUIRED.
2. HANG GENERATOR EXHAUST SILENCER FROM CEILING, SEE 15156 .
3. SPILL/FILL BOX SHALL BE WALL-MOUNTED, WITH 5 GALLON VOLUME, TRAMONT CORP, OR EQUAL.
4. PITCH DIESEL FILL LINE TOWARD FUEL TANK.

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SOUTH MILWAUKEE, WI

LIFT STATION
MECHANICAL
PLAN

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: J.T.H.
CHECKED BY: .
APPROVED BY: .

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 30-M-1

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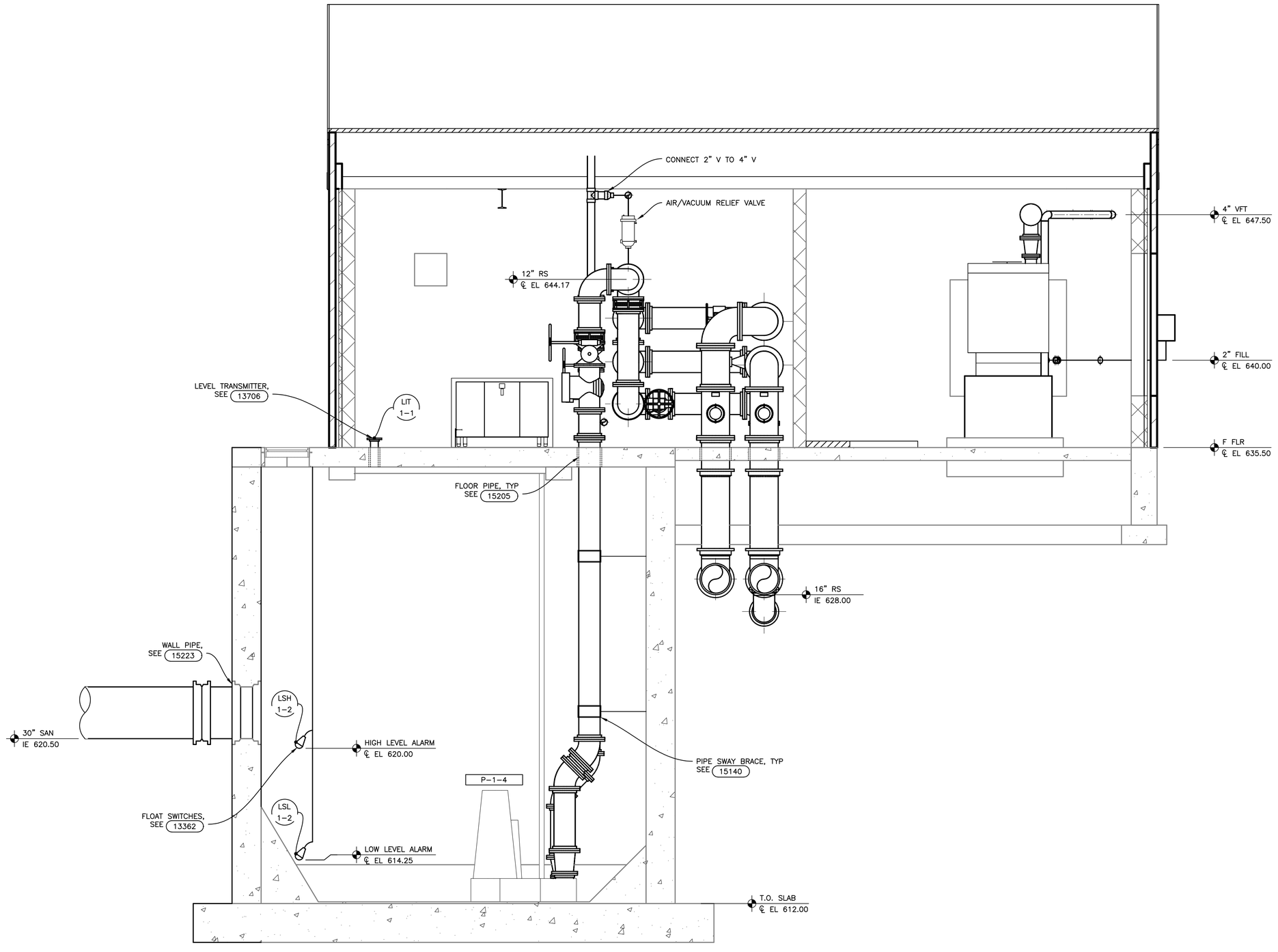

A / 30-M-2 SECTION A
3/8" = 1'-0"

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LIFT STATION
MECHANICAL
SECTION

VERIFY SCALES
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SCALE(S) ACCORDINGLY

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DRAWN BY: J.T.H.
CHECKED BY: .
APPROVED BY: .
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 30-M-2

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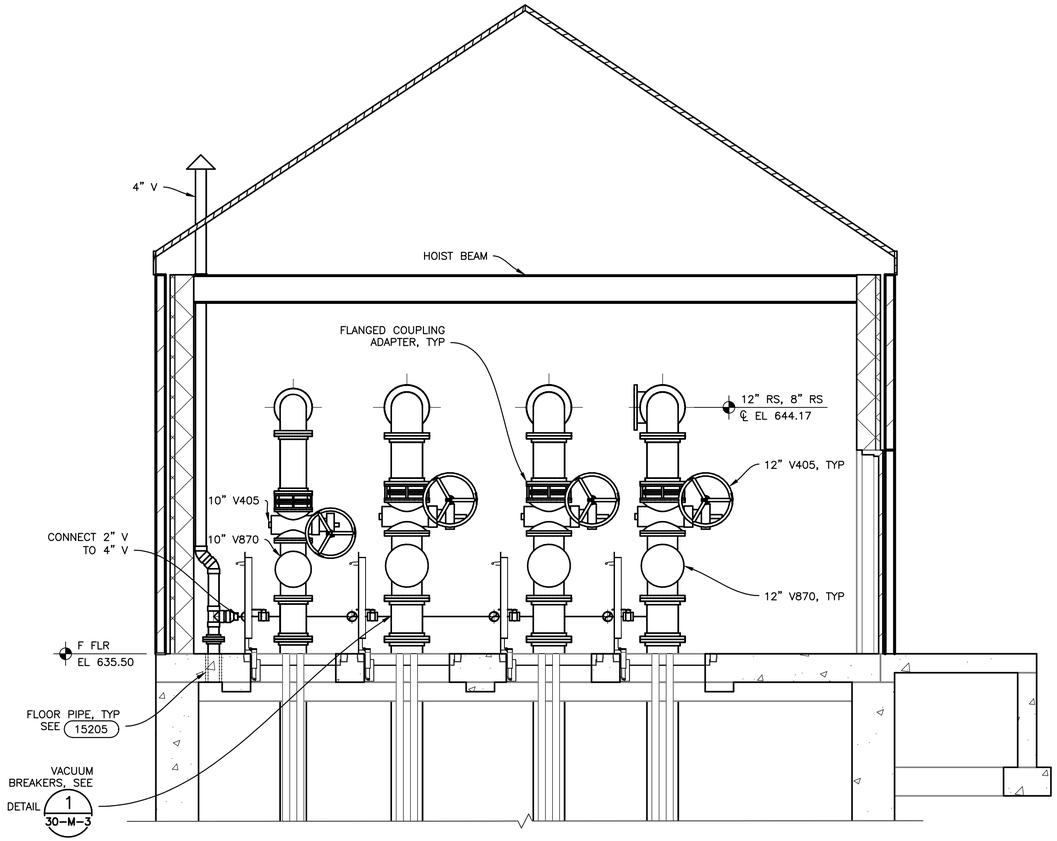
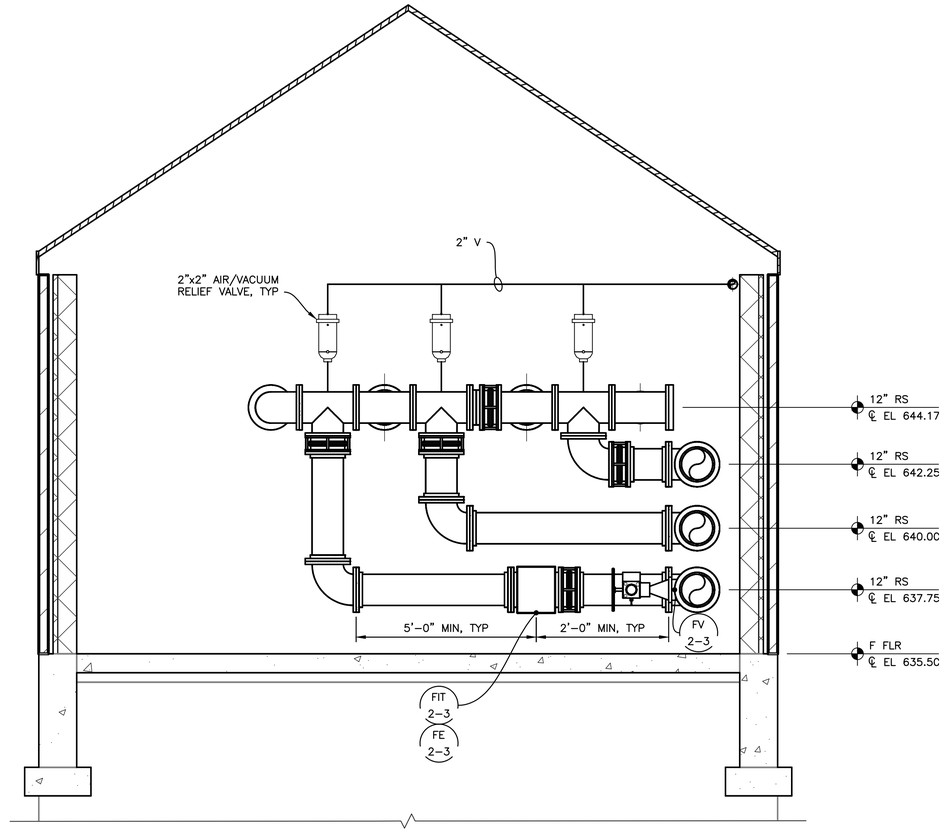
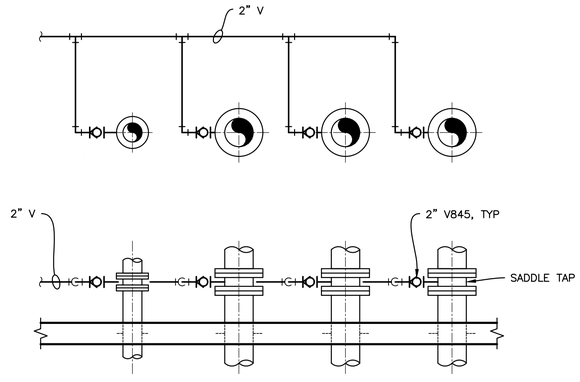


B 30-M-3 **SECTION B**
3/8" = 1'-0"



C 30-M-3 **SECTION C**
3/8" = 1'-0"



1 30-M-3 **VACUUM BREAKER**
N.T.S.

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MECHANICAL
SECTIONS

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DRAWN BY: J.T.H.
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APPROVED BY: .

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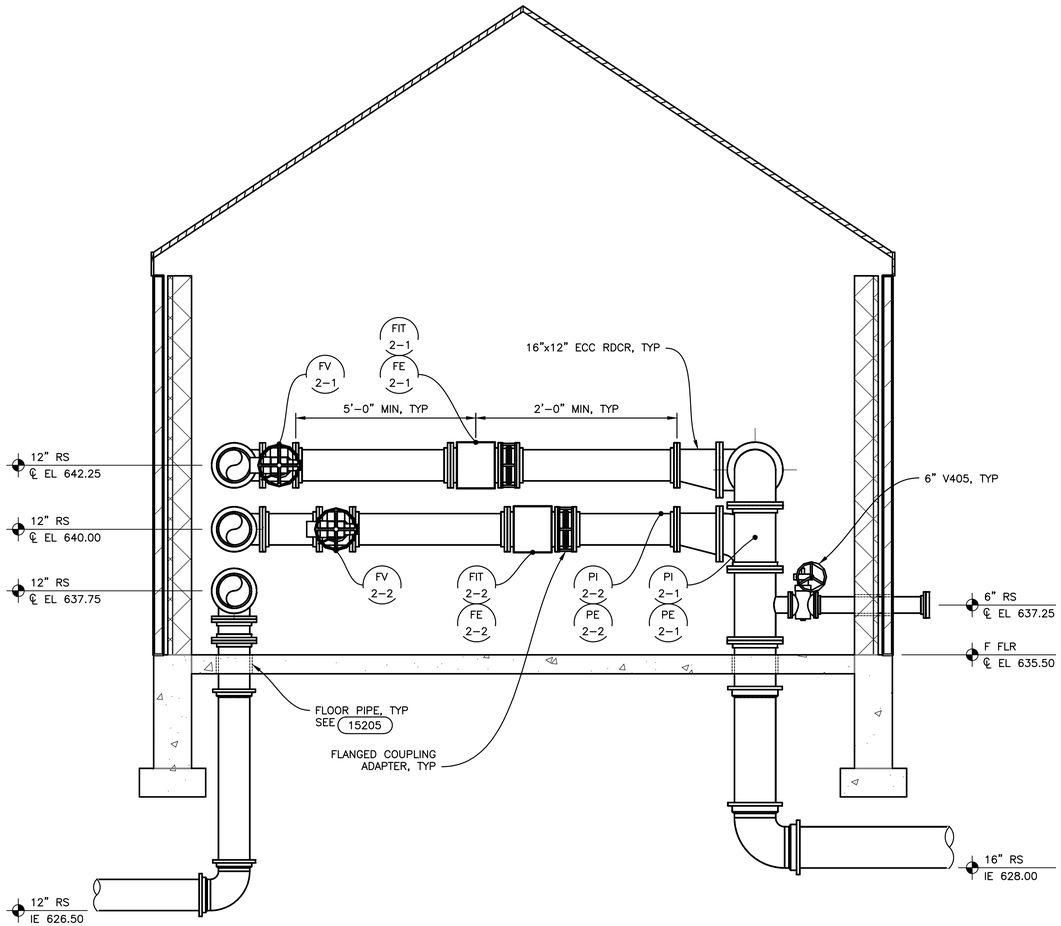
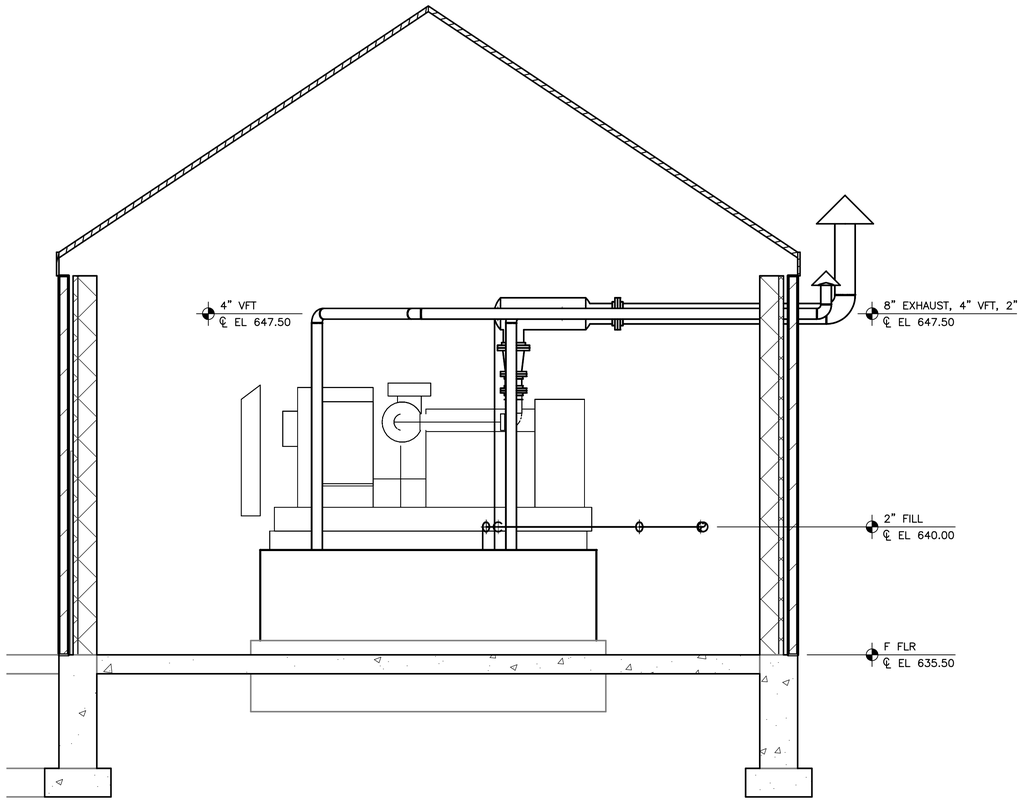


D 30-M-4 **SECTION D**
3/8" = 1'-0"



E 30-M-4 **SECTION E**
3/8" = 1'-0"

NOTES:

1. INSTALL MAGNETIC FLOW METERS IN ACCORDANCE WITH (13260).
2. INSTALL PRESSURE INDICATION IN ACCORDANCE WITH (13222).

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DRAWN BY: J.T.H.
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DATE APRIL 2018
DRAWING NO. 30-M-4

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ELECTRIC UNIT HEATERS

PLAN DESIGNATION		30-EUH-01	30-EUH-02	30-EUH-03
MANUFACTURER		INDEECO	INDEECO	Q-MARK
MODEL		233-FA-0086U	233-FA-0086U	MUH-07-4
KW		7.5	7.5	7.5
CFM		850	850	650
MOTOR	HP	1/4	1/4	1/30
	RPM	1,725	1,725	1,600
ELECTRICAL	AMPS	10	10	9
	VOLTS/PHASE	480V / 3Ø	480V / 3Ø	480V / 3Ø
OPERATING WEIGHT		150 LBS	150 LBS	38 LBS
REMARKS		1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	1, 2, 3

1. PROVIDE FACTORY MOUNTED AND WIRED DISCONNECT SWITCH.
2. PROVIDE FACTORY MOUNTED AND WIRED INTEGRAL THERMOSTAT.
3. MOUNT HEATER SUCH THAT THE BOTTOM OF UNIT IS AT A HEIGHT OF 8'-0" AFF.
4. PROVIDE STAINLESS STEEL MOUNTING BRACKET WITH EPOXY COATING.
5. UNIT HEATER SHALL BE CORROSION RESISTANT (316 STAINLESS STEEL CONSTRUCTION).
6. UNIT HEATER SHALL BE EXPLOSION PROOF.

LOUVERS

PLAN DESIGNATION		30-L-01	30-L-02	30-L-03
MANUFACTURER		GREENHECK	GREENHECK	GREENHECK
MODEL		ESK-402	ESK-402	ESK-402
CONSTRUCTION	TYPE	INTAKE	INTAKE	EXHAUST
	MATERIAL	ALUMINUM	ALUMINUM	ALUMINUM
CFM		3,500	16,650	15,500
SIZE	WIDTH	40"	88"	72"
	HEIGHT	40"	88"	72"
	DEPTH	4"	4"	4"
MAX FREE AREA VELOCITY - FPM		689	689	689
MAX PRESSURE DROP - IN WC		0.08	0.08	0.08
FINISH		KYNAR	KYNAR	KYNAR
REMARKS		1, 2	1, 2	1, 2

1. COORDINATE COLOR WITH ARCHITECT
2. PROVIDE WITH BIRD SCREEN

ELECTRIC CONTROL DAMPERS

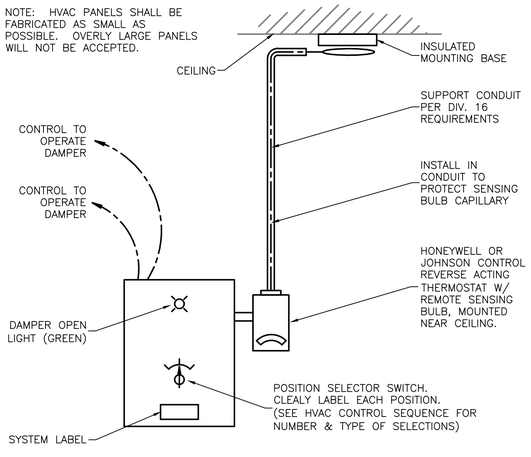
PLAN DESIGNATION	30-D-01	30-D-02	30-D-03
MANUFACTURER	TAMCO	TAMCO	TAMCO
MODEL	SERIES 1000	SERIES 9000	SERIES 9000
BLADE CONFIGURATION	PARALLEL	PARALLEL	PARALLEL
SIZE	40" x 40"	88" x 88"	72" x 72"
LOCATION	30-L-01	30-L-02	30-L-03
REMARKS	1, 2, 3, 4	1	1

1. PROVIDE WITH 120V BELIMO ACTUATOR.
   (VERIFY NUMBER OF ACTUATORS REQUIRED AND COORDINATE WITH ELECTRICAL CONTRACTOR)
2. PROVIDE WITH 3 COAT BAKED PHENOLIC COATING.
3. PROVIDE WITH CORROSION RESISTANT ACTUATOR HOUSING.
4. PROVIDE WITH EXPLOSION PROOF ACTUATOR HOUSING.

EXHAUST FANS

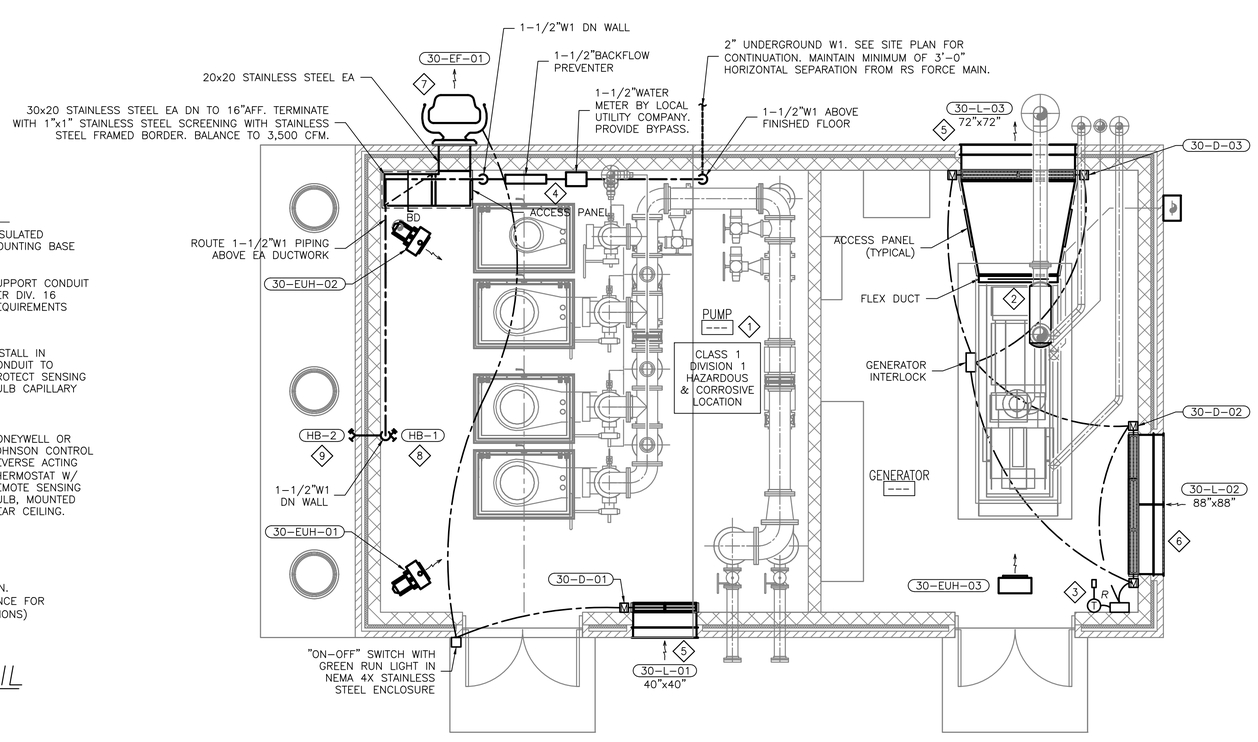
PLAN DESIGNATION		30-EF-01		
MANUFACTURER		GREENHECK		
MODEL		CWB-220		
SERVICE		PUMP ROOM		
LOCATION		EXT. WALL		
CONSTRUCTION	TYPE	SIDEWALL		
	CASING MATERIAL	ALUMINUM		
	FAN MATERIAL	ALUMINUM		
	DRIVE	BELT		
AIR	CFM	3,500		
	ESP - IN WC	0.25		
	FAN RPM	626		
ELECTRICAL	FAN MOTOR HP	3/4		
	FAN MOTOR BHP	0.63		
	VOLTS/PHASE	460V / 3Ø		
	THER OVERLOAD PROTECTION	BY DIVISION 16		
INLET dBA		59		
INLET SONES		9.7		
REMARKS		1, 2, 3, 4, 5		

1. PROVIDE GRAVITY BACKDRAFT DAMPER.
2. PROVIDE FACTORY MOUNTED AND WIRED DISCONNECT SWITCH.
3. PROVIDE HI-PRO POLYESTER COATING ON ALL PARTS INCLUDING DAMPER. COLOR TO BE EITHER GREY OR IVORY. FINAL SELECTION BY ARCHITECT.
4. PROVIDE AUTO BELT TENSIONER.
5. PROVIDE EXPLOSION PROOF MOTOR WITH EXPLOSION PROOF DISCONNECT.



HVAC CONTROL PANEL DETAIL

NTS



1 HVAC/PLUMBING PLAN

1/4" = 1'-0"

GENERAL NOTES

1. THESE DRAWINGS DO NOT ATTEMPT TO SHOW THE COMPLETE DETAILS OF BUILDING CONSTRUCTION, WHICH AFFECT THE HVAC & PLUMBING INSTALLATION. THE CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND REFER TO THE ARCHITECTURAL, CIVIL, STRUCTURAL, AND ELECTRICAL DRAWINGS FOR ADDITIONAL DETAILS WHICH AFFECT THE PROPER INSTALLATION OF THIS WORK. NO EXTRA PAYMENT WILL BE ALLOWED FOR THE FAILURE TO OBTAIN THIS INFORMATION.
2. HVAC & PLUMBING CONTRACTOR SHALL COORDINATE HIS WORK WITH EXISTING CONDITIONS AND WITH THE WORK OF OTHER TRADES. RESOLVE ALL CONFLICTS AT NO ADDITIONAL COST TO THE OWNER OR ARCHITECT.
3. THESE DRAWINGS ARE A DIAGRAMMATIC REPRESENTATION OF WORK TO BE ACCOMPLISHED AND AS SUCH DO NOT SHOW ALL REQUIRED OFFSETS OF DUCTWORK AND PIPING. HVAC & PLUMBING CONTRACTOR SHALL INSTALL MATERIAL AND EQUIPMENT AS TO CONFORM TO THE STRUCTURE, EQUIPMENT CONNECTIONS AND MAINTAIN EQUIPMENT SERVICE CLEARANCES, HEADROOM AND PASSAGEWAY.
4. DUCT SIZES ARE CLEAR INSIDE DIMENSIONS.
5. ALL CONTROL WIRING SHALL BE RUN IN CONDUIT.
6. MAINTAIN 10' MINIMUM DISTANCE FROM OUTSIDE AIR INTAKE TO ANY EXHAUST OR TOILET VENTS.

LEGEND

- HVAC EQUIPMENT
- DUCTWORK
- INSULATED DUCTWORK
- T — THERMOSTAT
- RT — REVERSE-ACTING THERMOSTAT
- DUCT UP
- DUCT DOWN
- FLEX DUCT
- M — MOTORIZED DAMPER
- BALANCING DAMPER
- AIR FLOW INDICATOR
- KEY NOTE
- W1 — DOMESTIC COLD WATER
- BALL VALVE
- PIPE ELBOW/TEE DOWN
- PIPE ELBOW/TEE UP
- CAPPED PIPE END
- AFF — ABOVE FINISHED FLOOR
- BD — BALANCING DAMPER
- CFM — CUBIC FEET PER MINUTE
- DN — DOWN
- EA — EXHAUST AIR
- MAX — MAXIMUM
- MIN — MINIMUM
- OA — OUTSIDE AIR

KEY NOTES

1. ALL DUCTWORK AND DUCTWORK ACCESSORIES LOCATED IN PUMP ROOM SHALL BE STAINLESS STEEL. ALL EXPOSED WATER PIPING IN PUMP ROOM SHALL BE SCHEDULE 80 CPVC.
2. PROVIDE DUCTED CONNECTION FROM GENERATOR RADIATOR TO LOUVER 30-L-03. COORDINATE RADIATOR CONNECTION SIZE WITH GENERATOR MANUFACTURER. PROVIDE ACCESS PANELS IN DUCTWORK.
3. HVAC CONTROL PANEL WITH "ON-OFF-AUTO" SWITCH AND REVERSE-ACTING THERMOSTAT WITH SENSING BULB NEAR THE CEILING FOR ELECTRIC CONTROL DAMPERS. SEE THE HVAC CONTROL PANEL DETAIL LOCATED ON THIS SHEET.
4. NEW BACKFLOW PREVENTER EQUAL TO WATTS SERIES LF909QT-S. PROVIDE WITH AIR GAP AND DRAIN LINE WITH TRAP. PIPE DRAIN THRU FLOOR AND STUB INTO WET WELL BELOW. PROVIDE WALL MOUNTING BRACKETS FOR MOUNTING BOTH THE BACKFLOW PREVENTER AND WATER METER. BACKFLOW PREVENTER AND WATER METER SHALL NOT BE SUPPORTED BY PIPING.
5. TOP OF LOUVER SHALL BE AT A HEIGHT OF 8'-8"AFF.
6. TOP OF LOUVER SHALL BE AT A HEIGHT OF 10'-0"AFF.
7. TOP OF WALL OPENING SHALL BE AT A HEIGHT OF 10'-0"AFF.
8. PROVIDE HOSE BIB (HB-1), SIMILAR TO STANDARD DETAIL 15340.
9. PROVIDE HOSE BIB (HB-2), SIMILAR TO STANDARD DETAIL 15352.

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N. CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION
HVAC/PLUMBING
PLAN

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: M.R.B.
DRAWN BY: M.R.B.
CHECKED BY: M.R.R.
APPROVED BY: M.R.R.

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 30-HP-1

PSLTSCALE: 1 LTSCALE: 1
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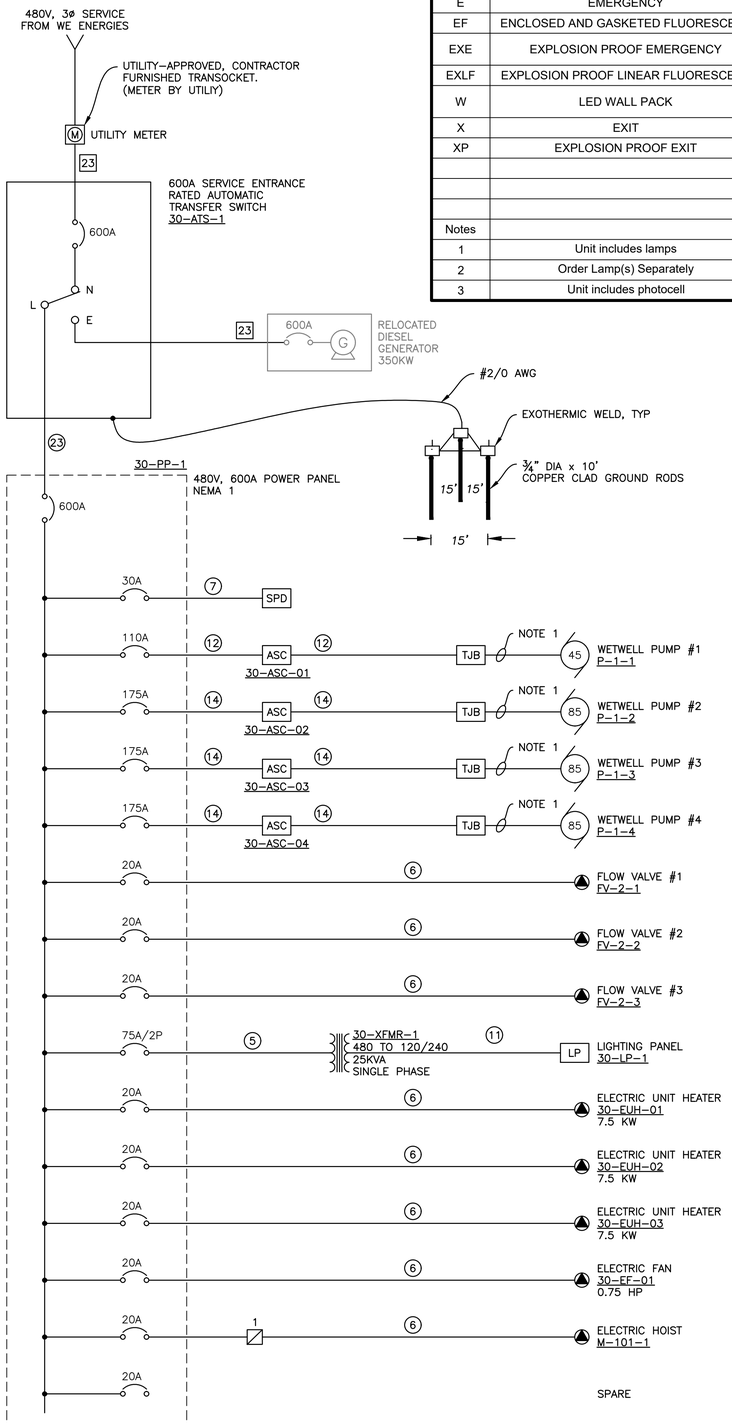
LIGHTING FIXTURE SCHEDULE

TYPE	FIXTURE DESCRIPTION	SIZE	MFR	CATALOG NUMBER	LAMP		VOLTS	MOUNTING	REMARKS
					QUANTITY	TYPE			
E	EMERGENCY	11" x 5"	LITHONIA	ELM2	N/A	LED	120	WALL	
EF	ENCLOSED AND GASKETED FLUORESCENT	52" x 6"	COLUMBIA	XEM4-232-RA-E120-SSL	2	T8	120	SUSPEND	2
EXE	EXPLOSION PROOF EMERGENCY	30" x 15"	CROUSE-HINDS / EATON	ELPS502	2	15W INCAND	120	WALL	1
EXLF	EXPLOSION PROOF LINEAR FLUORESCENT	53" x 12"	PHOENIX	LXFR-3-32-UNIV	3	T8	120	SUSPEND	1
W	LED WALL PACK	11" x 6"	HUBBELL	LNC2-12LU-4K-3-1-PC	N/A	LED	120	WALL	3
X	EXIT	13" x 8"	COMPASS / HUBBELL	CER	N/A	LED	120	UNIVERSAL	
XP	EXPLOSION PROOF EXIT	14" x 9"	ISOLITE	SLX-60SR10WHU		PHOSPHOR		UNIVERSAL	
Notes									
1	Unit includes lamps								
2	Order Lamp(s) Separately								
3	Unit includes photocell								



ONE-LINE DIAGRAM

PANEL: 30–LP–1	BUS AMPS: 225	MAIN CB SIZE: 100A @ 240V	MOUNTING	REMARKS:
	VOLTAGE: 120/240V		SURFACE ☒	
	PHASE: 1		FLUSH ☐	
	WIRE: 3			

CIRCUIT DESCRIPTION	CB	CKT	CKT	CB	CIRCUIT DESCRIPTION
LIGHTING – GENERATOR ROOM	20A	1	2	20A	(SPARE)
LIGHTING – EMERGENCY & EXIT	20A	3	4	20A	LIGHTING – EXTERIOR
RECEPTACLES – GENERATOR ROOM	20A	5	6	20A	RECEPTACLES – EXTERIOR
INSTRUMENTS – LIT1–1, FIT2–1, FIT2–2, FIT2–3	20A	7	8	20A	30–LCP–1–1
GENERATOR BATTERY CHARGER	20A	9	10	20A	GENERATOR CONTROL PANEL
GENERATOR ENGINE BLOCK HEATER	40A / 2	11 / 13	12	20A	PUMP ROOM DAMPER AND LIGHTS
			14	20A	(SPARE)
HVAC CONTROL PANEL, GEN RM DAMPERS	20A	15	16	20A	(SPARE)
(SPARE)	15A	17	18	15A	(SPARE)
		19	20		
		21	22		
		23	24		
		25	26		
		27	28		
		29	30		

NOTES:

1. CABLE FURNISHED WITH SUBMERSIBLE PUMP.
2. EQUIPMENT CONDUIT RUNS LEAVING THE CLASSIFIED AREA SHALL HAVE EXPLOSION PROOF SEALS LOCATED ON THE NON HAZARDOUS SIDE OF THE BOUNDARY.

CIRCUIT SCHEDULES

SINGLE–PHASE CIRCUIT SCHEDULE

AMPS	MARK	CONDUIT SIZE	PHASE CONDUCTORS				EQUIPMENT GROUNDING CONDUCTOR
20	1	3/4"	2#12				#12
30	2	3/4"	2#10				#10
50	3	3/4"	2#8				#10
60	4	3/4"	2#6				#10
80	5	1"	2#4				#8

3ø 3W & 4W CIRCUIT SCHEDULE

AMPS	3ø 3W MARK	CONDUIT SIZE	PHASE CONDUCTORS	3ø 4W MARK	CONDUIT SIZE	PHASE CONDUCTORS	EQUIPMENT GROUNDING CONDUCTOR
20	6	3/4"	3#12	6	3/4"	4#12	#12
30	7	3/4"	3#10	7	3/4"	4#10	#10
50	8	3/4"	3#8	8	3/4"	4#8	#10
60	9	1"	3#6	9	1"	4#6	#10
80	10	1"	3#4	10	1–1/4"	4#4	#8
100	11	1–1/4"	3#3	11	1–1/2"	4#3	#8
110	12	1–1/4"	3#2	12	1–1/2"	4#2	#6
125	13	1–1/2"	3#1	13	2"	4#1	#6
150	14	2"	3#1/0	14	2–1/2"	4#1/0	#6
200	15	2"	3#3/0	15	2–1/2"	4#3/0	#6
225	16	2–1/2"	3#4/0	16	3"	4#4/0	#4
250	17	2–1/2"	(3) 250 kcmil	17	3"	(4) 250 kcmil	#4
300	18	3"	(3) 350 kcmil	18	3–1/2"	(4) 350 kcmil	#4
350	19	3–1/2"	(3) 500 kcmil	19	4"	(4) 500 kcmil	#3
400	20	3–1/2"	(3) 600 kcmil	20	4"	(4) 600 kcmil	#3
450	21	(2) 2–1/2"	2 SETS OF (3)#4/0	21	(2) 3"	2 SETS OF 4#4/0	#2
500	22	(2) 2–1/2"	2 SETS OF (3) 250 kcmil	22	(2) 3"	2 SETS OF (4) 250 kcmil	#2
600	23	(2) 3"	2 SETS OF (3) 350 kcmil	23	(2) 3–1/2"	2 SETS OF (4) 350 kcmil	#1
700	24	(2) 3–1/2"	2 SETS OF (3) 500 kcmil	24	(2) 4"	2 SETS OF (4) 500 kcmil	#1/0
800	25	(2) 3–1/2"	2 SETS OF (3) 600 kcmil	25	(2) 4"	2 SETS OF (4) 600 kcmil	#1/0
900	26	(3) 3"	3 SETS OF (3) 350 kcmil	26	(3) 3"	3 SETS OF (4) 350 kcmil	#2/0
1000	27	(4) 2–1/2"	4 SETS OF (3) 250 kcmil	27	(4) 3"	4 SETS OF (4) 250 kcmil	#2/0
1200	28	(4) 3"	4 SETS OF (3) 350 kcmil	28	(4) 3–1/2"	4 SETS OF (4) 350 kcmil	#3/0
1600	29	(4) 3–1/2"	4 SETS OF (3) 600 kcmil	29	(4) 4"	4 SETS OF (4) 600 kcmil	#4/0
1800	30	(6) 3"	6 SETS OF (3) 350 kcmil	30	(6) 3"	6 SETS OF (4) 350 kcmil	250 kcmil
2000	31	(6) 3"	6 SETS OF (3) 500 kcmil	31	(6) 3–1/2"	6 SETS OF (4) 500 kcmil	250 kcmil
2500	32	(6) 3–1/2"	6 SETS OF (3) 600 kcmil	32	(6) 4"	6 SETS OF (4) 600 kcmil	350 kcmil
3000	33	(8) 3–1/2"	8 SETS OF (3) 500 kcmil	33	(8) 3–1/2"	8 SETS OF (4) 500 kcmil	400 kcmil
4000	34	(10) 3–1/2"	10 SETS OF (3) 600 kcmil	34	(10) 4"	10 SETS OF (4) 600 kcmil	500 kcmil

NOTE:

1. EQUIPMENT GROUNDING CONDUCTORS SHALL BE INSTALLED IN ALL CONDUITS INCLUDING SINGLE AND THREE PHASE, 2 WIRE, 3 WIRE AND 4 WIRE CIRCUITS.

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CITY OF SOUTH MILWAUKEE
N. CHICAGO LIFTSTATION
IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION
ELECTRICAL
ONE-LINE DIAGRAM & SCHEDULES

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: N.A.O.
DRAWN BY: J.T.H.
CHECKED BY: .
APPROVED BY: .

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 30-E-1

PSLTSCALE: 1 LTSCALE: 1
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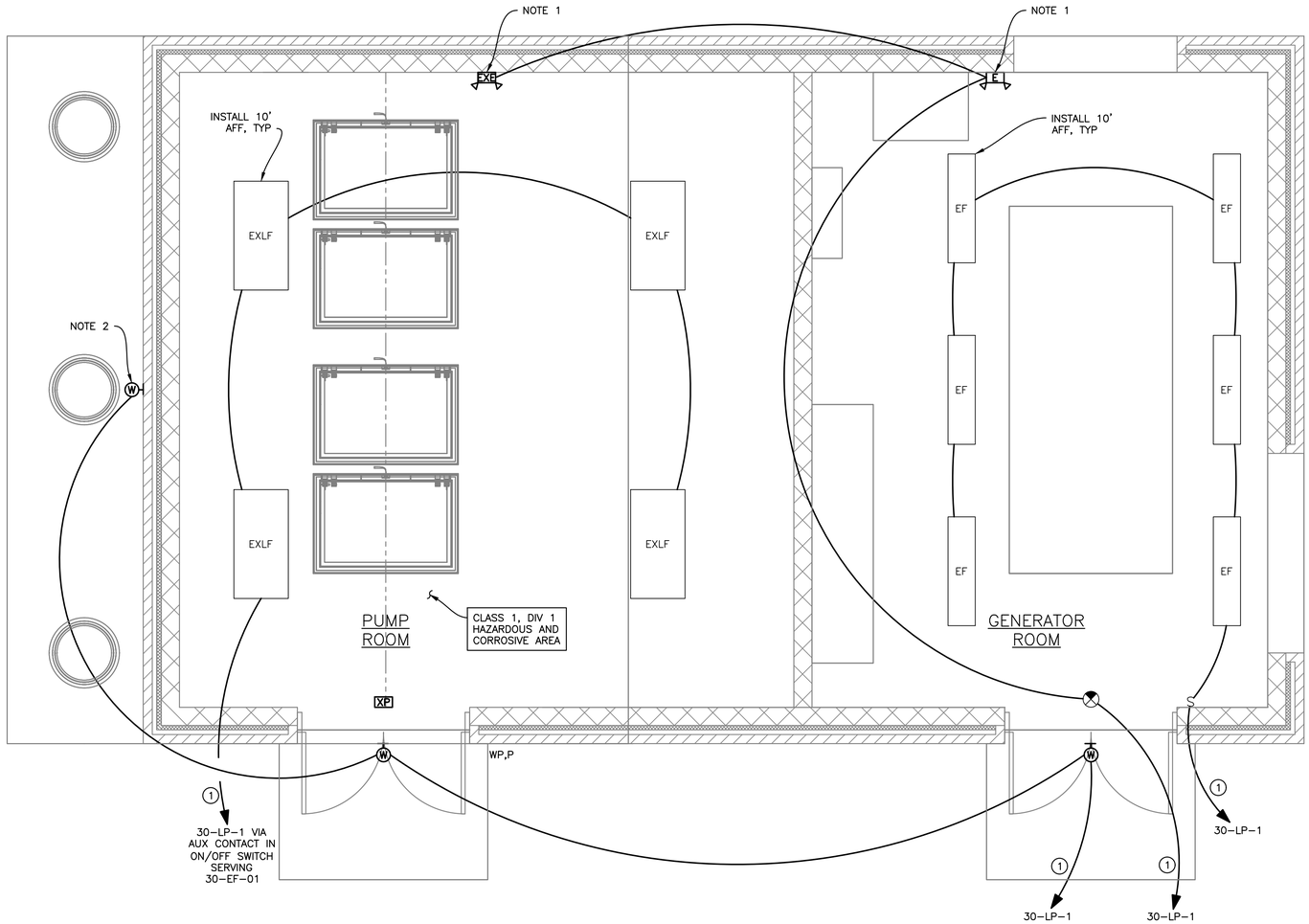
NOTES:

1. PUMP ROOM IS RATED CLASS 1 DIV 1. CONDUIT RUN CONNECTING EMERGENCY LIGHTS SHALL INCLUDE SEAL OFFS AS PER NEC ARTICLE 501.
2. EXTERIOR LIGHT REFERENCED BY THIS NOTE SHALL BE MOUNTED TO MATCH HEIGHT OF EXTERIOR LIGHTS ABOVE DOORS,



N
PLAN NORTH

LIGHTING PLAN

3/8" = 1'-0"

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N. CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION
ELECTRICAL
PLAN

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: N.A.O.
DRAWN BY: J.T.H.
CHECKED BY: .
APPROVED BY: .
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 30-E-2

PSLTSCALE: 1 LTSCALE: 1
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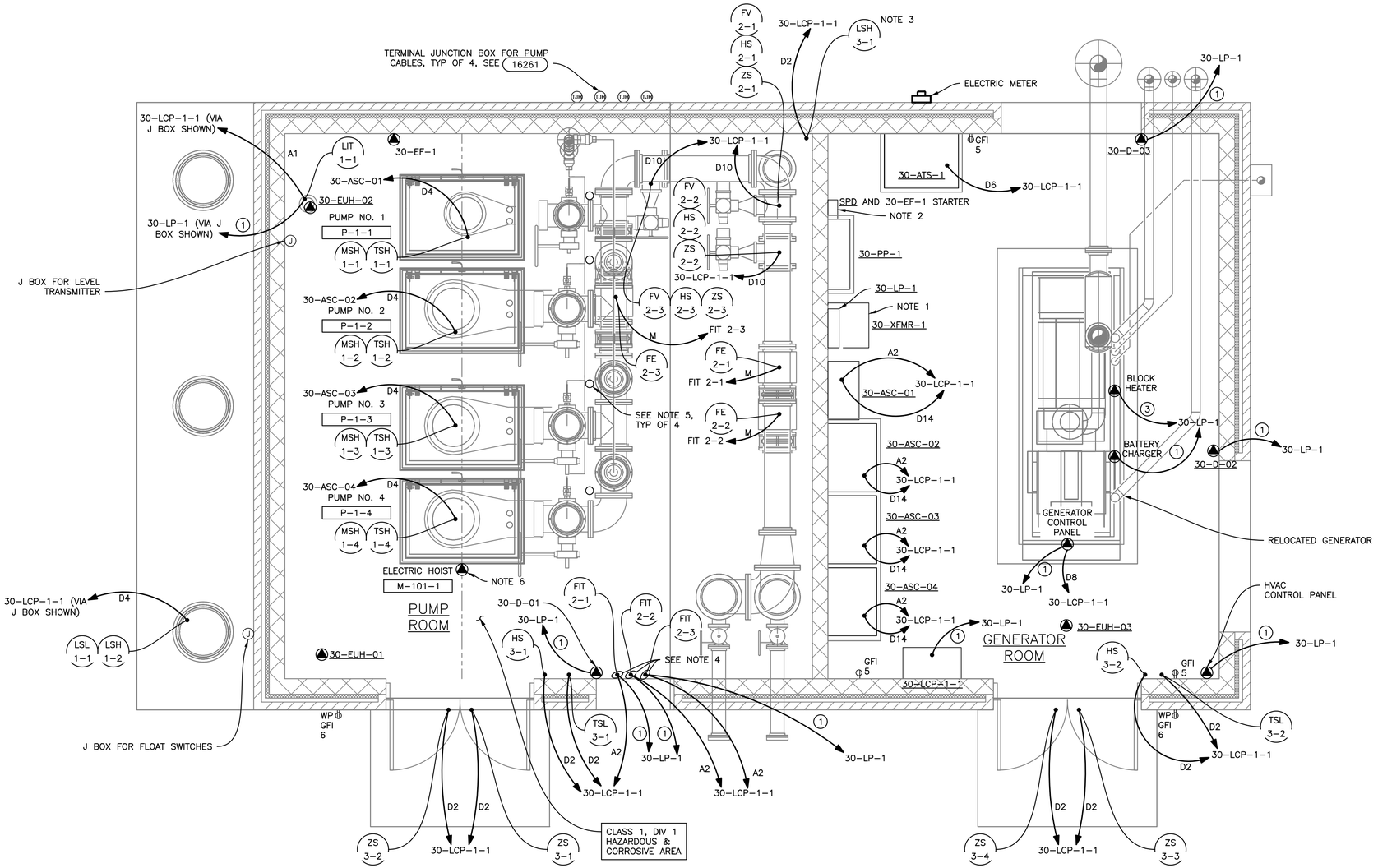
NOTES:

1. 30-XFMR-1 TO BE WALL MOUNTED ABOVE 30-LP-1, BUT XFMR SHALL BE POSITIONED A MIN. OF 6" INFRONT OF LIGHTING PANEL (OFFSET, PER NEC).
2. SPD AND 30-EF-1 STARTER TO BE SIDEMOUNTED ON WALL NEXT TO 30-PP-1.
3. MOUNT LOW ON WALL PER MANUFACTURER INSTRUCTION.
4. TRANSMITTERS FOR FLOW METERS SHALL BE WALL MOUNTED BELOW HVAC LOUVER.
5. CONDUIT STUB UPS FOR PUMP POWER CABLES. THIS CONDUIT SHALL NOT RUN BETWEEN PUMP HATCHES AND VALVES SO AS NOT TO INTERFERE WITH VALVE ACCESS AND OPERATION. THESE CONDUITS SHALL RUN TO THEIR RESPECTIVE TERMINAL JUNCTION BOXES OUTSIDE, BUT THEY SHALL NOT BE ROUTED IN, UNDER OR ACROSS THE FLOOR.
6. CONFIRM EXACT LOCATION OF HOIST CONNECTION PRIOR TO INSTALLATION.



N
PLAN NORTH

POWER & SYSTEM PLAN

3/8" = 1'-0"

city of South Milwaukee — Proud Past ... Promising Future

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N. CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WI

LIFT STATION
ELECTRICAL
PLAN

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	N.A.O.
DRAWN BY:	J.T.H.
CHECKED BY:	.
APPROVED BY:	.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	30-E-3

PSLTSCALE: 1 LTSCALE: 1
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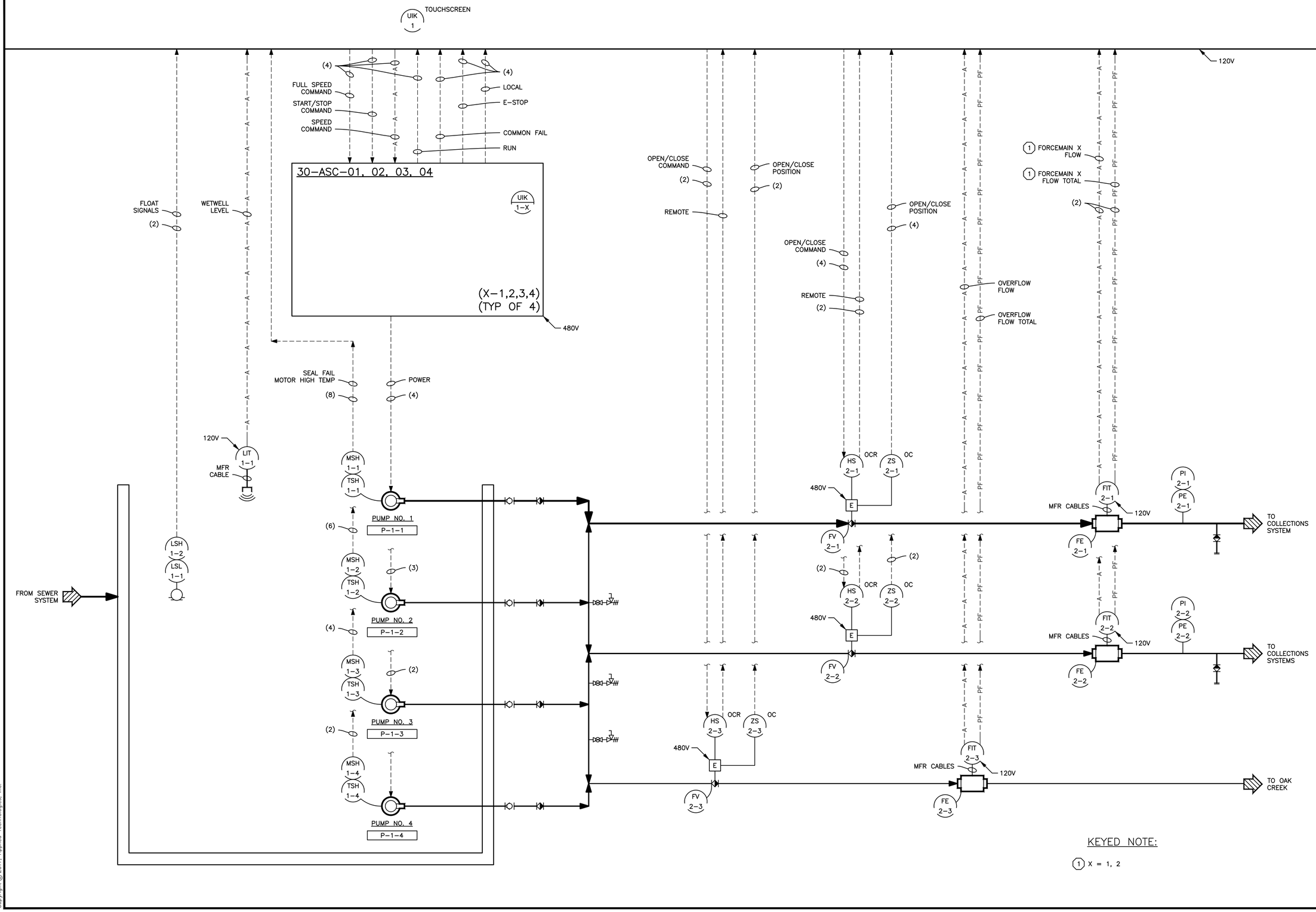
30-LCP-1-1 (PARTIAL)



KEYED NOTE:

(1) X = 1, 2

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NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

INSTRUMENTATION & CONTROL
LIFT STATION
P&ID

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO.
5795

DATE
APRIL 2018

DRAWING NO.
90-I-1

PSLTSCALE: 1 LTSCALE: 1
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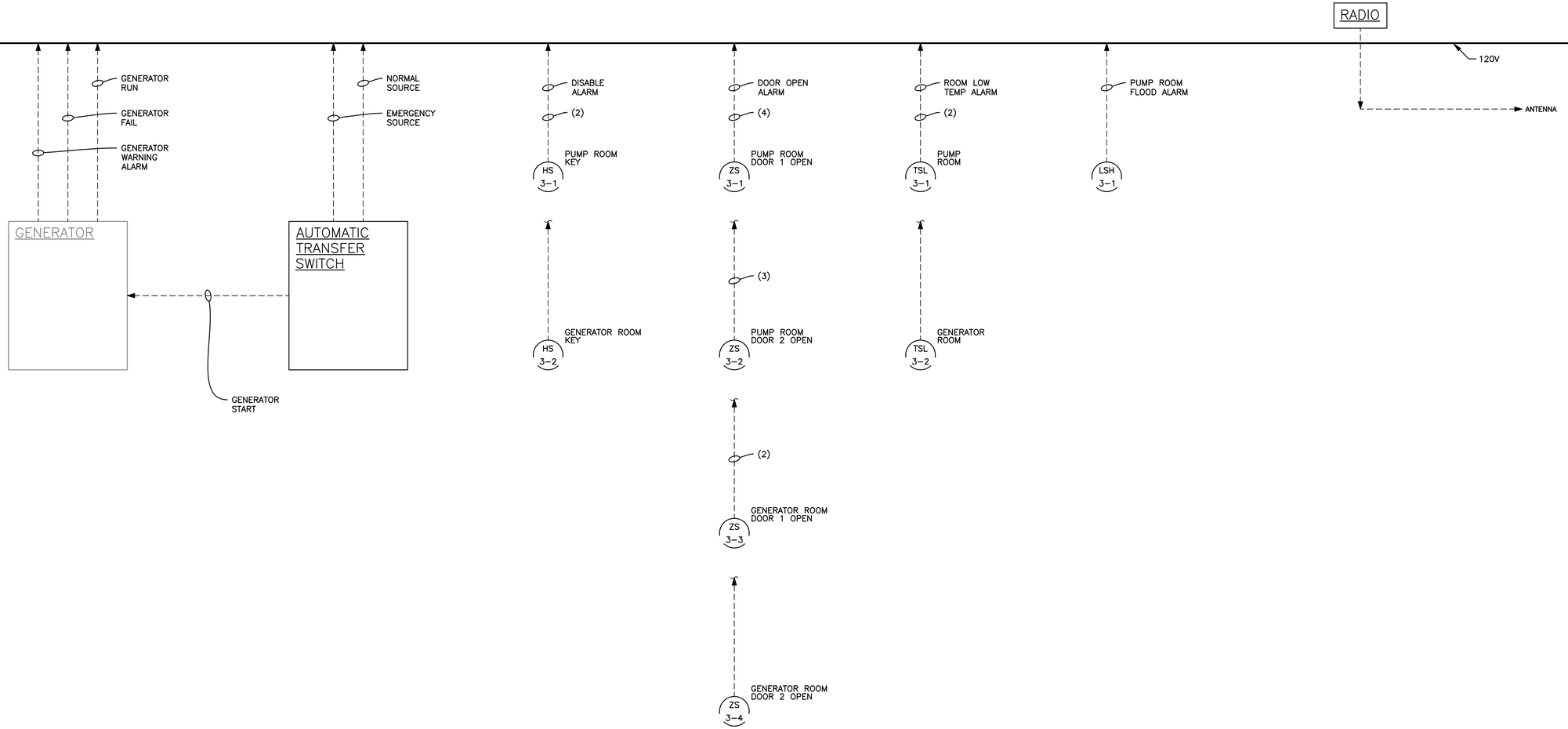
30–LCP–1–1 (PARTIAL)



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NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

INSTRUMENTATION & CONTROL
BACKUP POWER & SECURITY
P&ID

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 90-I-2

PSLTSCALE: 1 LTSCALE: 1
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WASTEWATER TREATMENT FACILITY

CONTROL BUILDING

LCP–80 CONTROL BUILDING
SCADA PANEL

COLOR TOUCHSCREEN

FOIC

FIBER JUMPER

FIBER CABLE

EXISTING WONDERWARE SCADA COMPUTER SYSTEM

TO PLANT INTERNET SERVICE PROVIDER

CAT 5 CABLE

EXISTING MCP
SCADA PANEL

FIBER JUMPER

FOIC

1

FIBER JUMPER

EXISTING MASTER SCADA PANEL

SCADA PACK

DIAL–UP MODEMS (3)

COMMUNICATION POLL LIST

N. CHICAGO LAKE DR. RAVINE SOUTHEAST MISSOURI

MARQUETTE OAK CHESTNUT LIFT STATION 6

HARDWIRED INTERFACE

EXISTING DIALER

EXISTING FIBER CABLE

EXISTING LCP–50 HEADWORKS
CONTROL PANEL

FOIC

FIBER JUMPER

LCP–75 DISINFECTION BUILDING
CONTROL PANEL

COLOR TOUCHSCREEN

FOIC

FIBER JUMPER

EXISTING LCP–60 LIFT STATION/BLOWER
CONTROL PANEL

COLOR TOUCHSCREEN

FOIC

1

FIBER JUMPER

LEGEND

FOIC — FIBER OPTIC INTERCONNECT CENTER

FIBER CONVERTER/SWITCH

1761–NET–ENI ALLEN–BRADLEY ETHERNET INTERFACE FOR MICROLOGIX PLC

ALLEN–BRADLEY MICROLOGIX 1500 PLC

AUTOMATION DIRECT COLOR TOUCH SCREEN

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SOUTH MILWAUKEE, WISCONSIN

INSTRUMENTATION & CONTROL
NETWORK RISER
REMOVAL DIAGRAM

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: A.S.D.
DRAWN BY: J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO.
5795

DATE
APRIL 2018

DRAWING NO.
90-I-3

PSLTSCALE: 1 LTSCALE: 1
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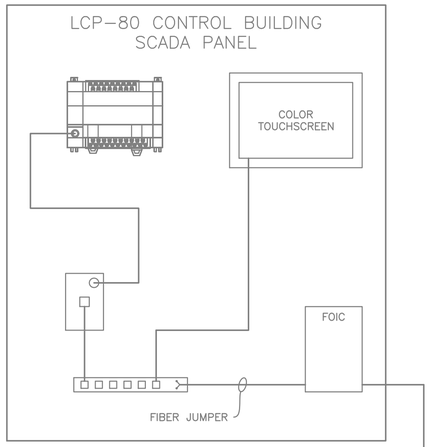
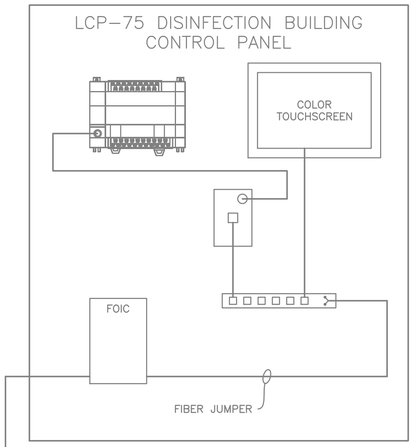
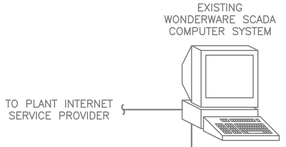
WASTEWATER TREATMENT FACILITY

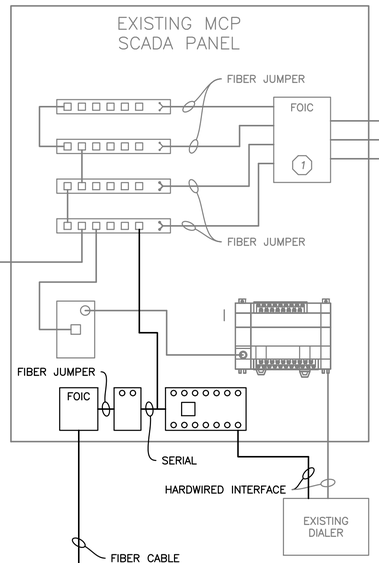


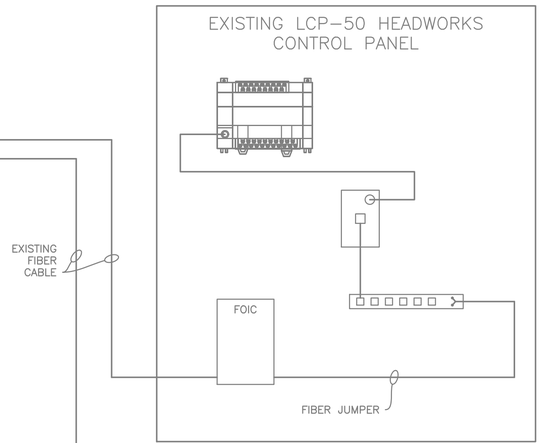


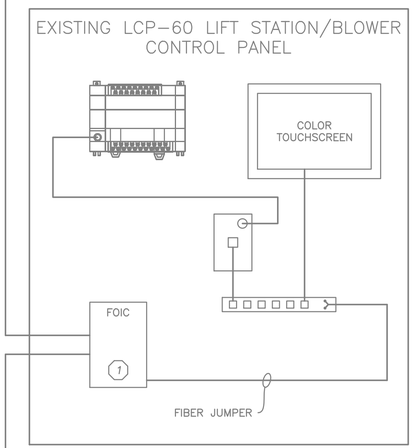
FIBER CABLE

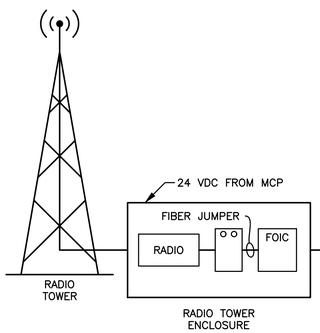
FIBER CABLE











ELECTRICAL CONTROL
BUILDING NO. 1

ELECTRICAL CONTROL
BUILDING NO. 2

KEYED NOTES:

(1) UPGRADE OR REPLACE OR ADD FOIC PANEL TO ACCEPT ADDITIONAL FIBER OPTIC CABLE.

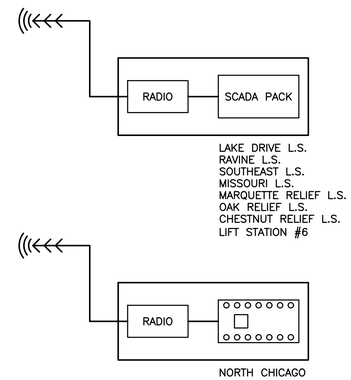
NOTE:

1. SEE SPECIFICATION SECTION 13323 FOR TOWER AND LIFT STATION STREET ADDRESSES. SEE ALSO DRAWINGS 10–G–1, 20–G–1, AND 20–G–2.

LEGEND

- RADIO — 900 MHZ SPREAD SPECTRUM RADIO
- FOIC — FIBER OPTIC INTERCONNECT CENTER
- FIBER CONVERTER/SWITCH
- 1761–NET–ENI ALLEN–BRADLEY ETHERNET INTERFACE FOR MICROLOGIX PLC
- ALLEN–BRADLEY MICROLOGIX 1500 PLC
- AUTOMATION DIRECT COLOR TOUCH SCREEN
- ALLEN–BRADLEY MICROLOGIX 1400 PLC

COLLECTION SYSTEM



city of South Milwaukee
Proud Past ... Promising Future

Applied Technologies
Engineers–Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

INSTRUMENTATION & CONTROL
NETWORK RISER
INSTALL DIAGRAM

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: A.S.D.
DRAWN BY: J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 90-I-4

PSLTSCALE: 1 LTSCALE: 1
J:\5795 – S Mke\GRAPHICS\DRAWINGS\90–I–4 INSTALL DIAGRAM.dwg Last Modified: 17 April 2018 Plotted On: 4/17/2018 10:39 AM by PHIL GERLACH
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CONCRETE BEAM SCHEDULE

BEAM NO.	BEAM TYPE (SEE 03450)	ELEVATION TOP OF BEAM	SIZE		REINFORCING				SIDE BARS	SHEAR REINFORCING			REMARKS
			WIDTH	HEIGHT	TOP BARS	BOTTOM BARS	"C" BARS	"E" BARS		SIZE	END SPACING	SPACING INTERMEDIATE	
CB1	TYPE A	635.50'	16"	20"	(3) #6	(3) #6	N/A	N/A	(2) #4	#3	14 @ 8" O.C.	@ 11" O.C	
CB2	TYPE A	635.50'	12"	16"	(3) #5	(3) #5	N/A	N/A	(2) #4	#3	3 @ 8" O.C.	@ 11" O.C.	

FOUNDATION SCHEDULE

MARK	TYPE	WIDTH	LENGTH	FOUNDATION THICKNESS	TOP REINFOCING	BOTTOM REINFORCING	REFERENCE DETAIL NO.	NOTES
TF1.33	THICKENED SLAB	1'-4"	CONT	1'-0"	N/A	(2) #5 CONT. / #4@12" S.W.	03120	
WF2.33	WALL FTG	2'-4"	CONT	1'-4"	N/A	(3) #5 CONT. / #4@12" S.W.	03112	
WF1.83	WALL FTG	1'-10"	CONT	1'-0"	N/A	(2) #5	03319	
F26.80 + 30	SPREAD FTG	26'-10"	30'-0"	2'-0"	#6 @ 12" E.W.	#6 @ 12" O.C., E.W.		WET WELL BASE

EXTERIOR FINISH SCHEDULE

COMPONENT	MATERIAL	FINISH	COLOR
Standing Seam Metal Roof	Galv. Steel	A-1	S.B.O.
Snow Rails	Galv. Steel	A-1	S.B.O.
Fascia	Galv. Steel	A-1	S.B.O.
Gutters and Downspouts	Aluminum	A-1	S.B.O.
Brick Veneer	Clay Brick	Velour	S.B.O.
Doors	FRP	FF	S.B.O.
Frames	FRP	FF	S.B.O.
Louvers	Aluminum	A-1	S.B.O.
Exhaust Fan	Aluminum	FF	S.B.O.
Miscellaneous Flashing/Trim	Varies	A-1	S.B.O.

EXTERIOR FINISH NOTES:

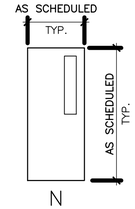
1. SUBMIT COLOR SAMPLE FOR ALL MATERIAL AT THE SAME TIME SO THAT THE OWNER CAN MAKE AN INFORMED SELECTIONS BASED ON RELATIONSHIPS OF THE COMPONENTS.
2. A-1: AAMA 2605 MINIMUM 2 COATS FLUOROPLOYMER COATING WITH MINIMUM 70% POLYVINYLIDENE FLURIDE RESIN.

LINTEL SCHEDULE

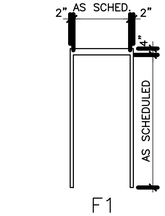
MARK	MEMBER SIZE	DETAIL REFERENCE	REMARKS
L-1	8"x8" CMU	04564 & 04566	REINFORCE W/ (2)#5 BOTTOM
L-2	(2) 8"x8"CMU / 8"x16" CMU	04564 & 04566	REINFORCE W/ (2)#5 EACH COURSE

DOOR AND FRAME SCHEDULE

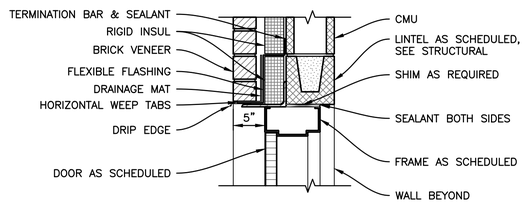
MARK	DOOR TYPE	DOOR SIZE WIDTH	DOOR SIZE HEIGHT	DOOR SIZE THK	DOOR MATL	DOOR GLAZING	DOOR LOUVER WIDTH	DOOR LOUVER HEIGHT	FRAME TYPE	FRAME DEPTH	FRAME MATL	FRAME EL	FRAME DETAIL HEAD	FRAME DETAIL JAMB	FRAME DETAIL SILL	FIRE RATING LABEL	HARDWARE SET NO	HARDWARE KEYSIDE RM NO	NOTES
101	N	PAIR 3'-0"	7'-0"	1-3/4"	FRP	ITG	N/A	N/A	F1	8-3/4"	FRP	7'-4"	1	2	3	N/A	1	EXT	
102	N	PAIR 3'-0"	7'-0"	1-3/4"	FRP	ITG	N/A	N/A	F1	8-3/4"	FRP	7'-4"	1	2	3	N/A	1	EXT	



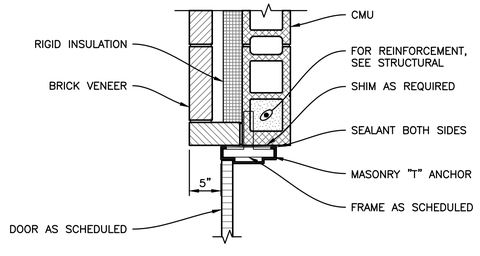
DOOR TYPES



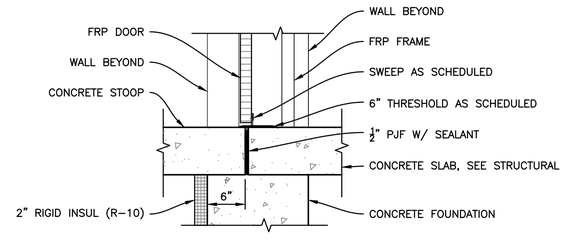
FRAME TYPES



1 HEAD
1" = 1'-0"



2 JAMB
1" = 1'-0"



3 SILL
1" = 1'-0"

ROOM FINISH SCHEDULE

ROOM NUMBER	ROOM NAME	FLOOR MATL	FLOOR FINISH	WALLS BASE MATL	WALLS BASE HEIGHT	WALLS NORTH MATL	WALLS NORTH FINISH	WALLS SOUTH MATL	WALLS SOUTH FINISH	WALLS EAST MATL	WALLS EAST FINISH	WALLS WEST MATL	WALLS WEST FINISH	CEILING / TRIM MATL	CEILING / TRIM FINISH	CEILING / TRIM HEIGHT	NOTES
101	PUMP ROOM	CONC	SEALER	N/A	N/A	CMU	P-109	CMU	P-109	CMU	P-109	CMU	P-109	GYP BD	P-115	13'-4"	
102	GENERATOR ROOM	CONC	SEALER	N/A	N/A	CMU	P-109	CMU	P-109	CMU	P-109	CMU	P-109	GYP BD	P-115	13'-4"	

city of South Milwaukee — Proud Past ... Promising Future

Applied Technologies Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SCHEDULES
ARCHITECTURAL/STRUCTURAL SCHEDULES

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: B.A.G.
DRAWN BY: J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 95-AS-1

PSLTSCALE: 1 LTSCALE: 1
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PIPE SCHEDULE

SERVICE	LEGEND	SIZE (INCHES)	SPECIFICATION SECTION (SEE NOTE 2)	MATERIAL (SEE NOTE 3)	INSTALLATION	TEST PRESSURE AND TYPE (PSIG, X) (SEE NOTE 4)	MAX OPERATING PRESSURE (PSIG)	MAX OPERATING TEMPERATURE (°FAHRENHEIT)	COLOR CODE	REMARKS
FUEL FILL	FILL	ALL	15008	STL	EXPOSED	5, P	10	100	SAFETY YELLOW	
GENERATOR EXHAUST	EXHAUST	ALL	15014	SST	EXPOSED	N/A	2	1200	NOT PAINTED	INSULATE PIPING PER SPECIFICATION 15562
FORCE MAIN	FM	ALL	15004	CLDI	BURIED	150, H	100	75		UNDER BUILDING AND WITHIN 10 FT OF FOOTING
FORCE MAIN	FM	ALL	15021	PVC	BURIED	150, H	100	75		
OVER FLOW	OF	ALL	15004	CLDI	BURIED	150,H	100	75		
RAW SEWAGE	RS	ALL	15004	CLDI	EXPOSED / BURIED	150, H	100	75	GRAY	LIFT STATION PIPING
SANITARY SEWER	SAN	ALL	02611	PVC	BURIED	5, H	ATM	75		
VENT	V	ALL	15030	PVC	EXPOSED / BURIED	5, H	ATM	75	GRAY	
VENT, FUEL TANK	VFT	ALL	15008	STL	EXPOSED	5, P	ATM	100	GRAY	
WATER, POTABLE	W1	<2.5	15420	CU	BURIED	100, H	60	75	SAFETY BLUE	INSULATE EXPOSED PIPING PER SPECIFICATION 15408
WATER, POTABLE	W1	<2.5	15420	CPVC	EXPOSED	100, H	60	75	SAFETY BLUE	INSULATE EXPOSED PIPING PER SPECIFICATION 15408

NOTES:

1. SYMBOLS > : GREATER THAN OR EQUAL TO
   < : LESS THAN OR EQUAL TO
2. PIPE SPECIFICATIONS – SEE SECTIONS 15000 THROUGH 15030
3. MATERIALS:
   CISP – CAST IRON SOIL PIPE
   CLDI – CEMENT LINED DUCTILE IRON
   CPVC – CHLORINATED POLYVINYL CHLORIDE
   CU – COPPER
   DIP – DUCTILE IRON (UNLINED)
   FRP – FIBERGLASS REINFORCED PIPE
   FSTL – FABRICATED STEEL PIPE
   GLDI – GLASS LINED DUCTILE IRON
   GSTL – GALVANIZED STEEL
   NRCP – NON–REINFORCED CONCRETE PIPE
   PCCP – PRESTRESSED CONCRETE CYLINDER PIPE
   PE – POLYETHYLENE
   PIP – PREFABRICATED INSULATED PIPE
   PPL – POLYPROPELYNE
   PPLS – POLYPROPELYNE–LINED STEEL
   PSTL – PVDF–LINED STEEL
   PVC – POLYVINYL CHLORIDE
   PVDF – POLYVINYLIDENE FLUORIDE PLASTIC PIPE
   RCP – REINFORCED CONCRETE PIPE
   SST – STAINLESS STEEL
   STL – CARBON STEEL
   VCP – VITRIFIED CLAY PIPE
4. TESTING METHOD (X) : H = HYDROTEST
   P = PNEUMATIC
5. FOR INSULATED PIPING PAINT THE OUTSIDE OF THE INSULATION.
6. FOLLOW SPECIFIC PIPING REQUIREMENTS AS CALLED OUT ELSEWHERE ON DRAWINGS AND SPECIFICATIONS.

city of South Milwaukee
Proud Past ... Promising Future

Applied Technologies
Engineers - Architects

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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

SCHEDULES
MECHANICAL
SCHEDULES

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: P.C.G.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO.
5795

DATE
APRIL 2018

DRAWING NO.
95-M-1

PSLTSCALE: 1 LTSCALE: 1
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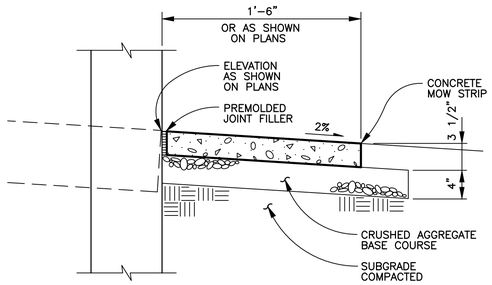
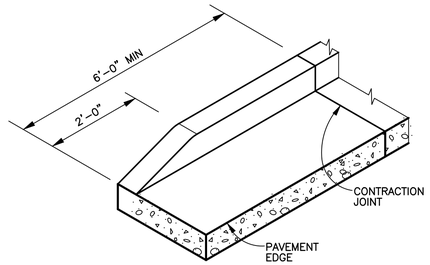


CONCRETE MOW STRIP 02015

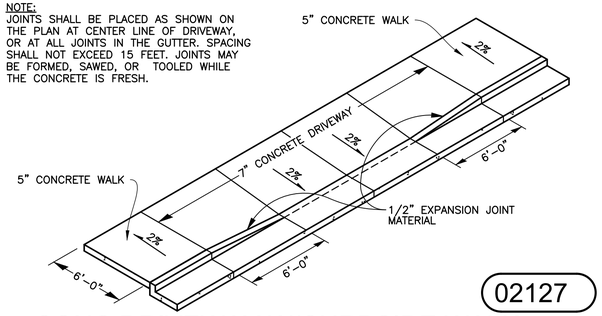
NTS



CURB TAPER 02106

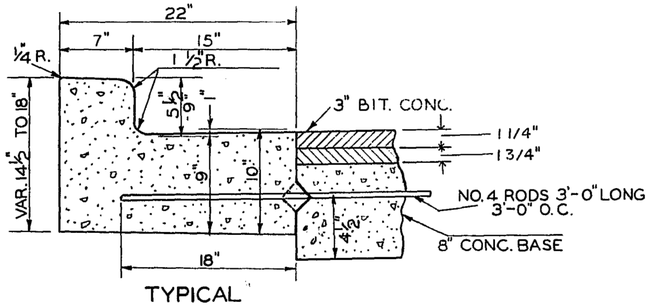
NTS

NOTE:
JOINTS SHALL BE PLACED AS SHOWN ON THE PLAN AT CENTER LINE OF DRIVEWAY, OR AT ALL JOINTS IN THE GUTTER. SPACING SHALL NOT EXCEED 15 FEET. JOINTS MAY BE FORMED, SAWED, OR TOOLED WHILE THE CONCRETE IS FRESH.



CONC DRIVEWAY W/CURBSIDE WALK 02127

NTS

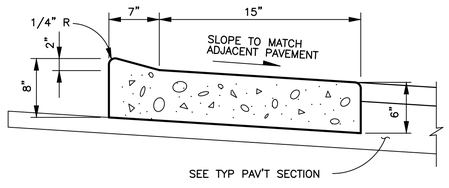


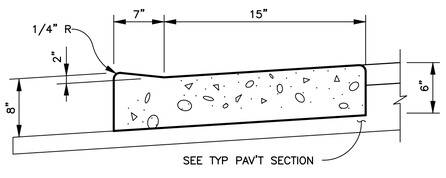
TYPICAL

22" CONCRETE CURB & GUTTER

CURB AND GUTTER 02101

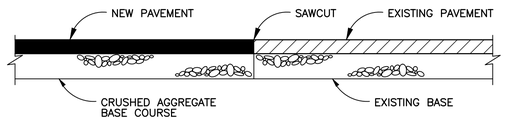
NTS





DEPRESSED CURB & GUTTER 02102

NTS

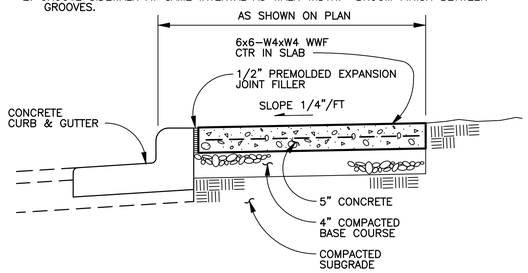


BUTT JOINT 02110

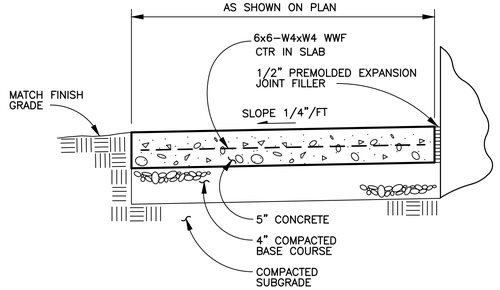
NTS

NOTES:

1. PROVIDE 1/4"PREMOLDED EXPANSION JOINT FILLER AT EVERY JOINT OF WALKWAY INTERSECTION AND SPACING NOT GREATER THAN 20' IN SIDEWALK.
2. GROOVE SIDEWALK AT SAME INTERVAL AS WALK WIDTH. BROOM FINISH BETWEEN GROOVES.



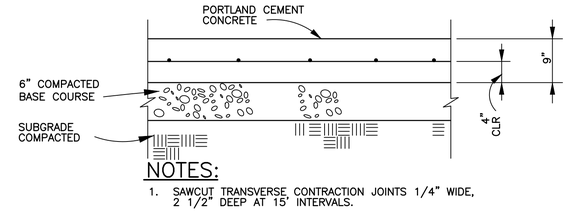
AT PARKING LOTS & CURBED ROADWAYS



BETWEEN STRUCTURES AND GRASSED AREAS

TYP CONCRETE WALK 02120

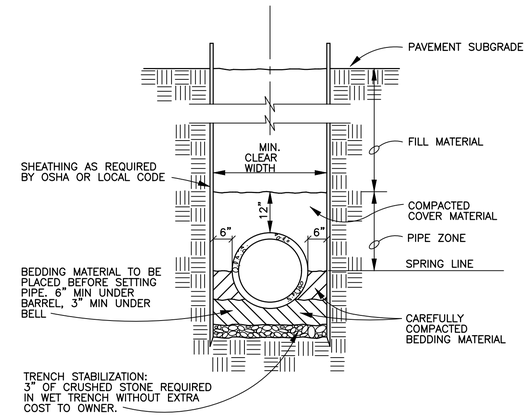
NTS



NOTES:

1. SAWCUT TRANSVERSE CONTRACTION JOINTS 1/4" WIDE, 2 1/2" DEEP AT 15' INTERVALS.

PORTLAND CEMENT CONCRETE PAVEMENT 02132



TYPICAL TRENCH W/ CLASS "B" BEDDING 02281

NTS

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NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
CIVIL
DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY:	W.A.H./P.C.G.
DRAWN BY:	P.C.G.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	99-C-1

PSLTSCALE: 1 LTSCALE: 1
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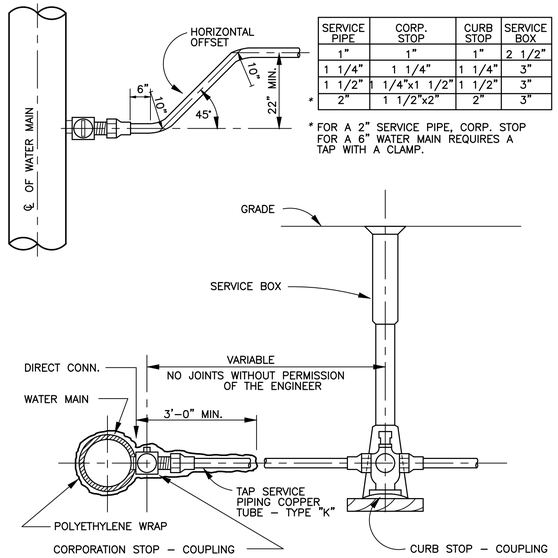
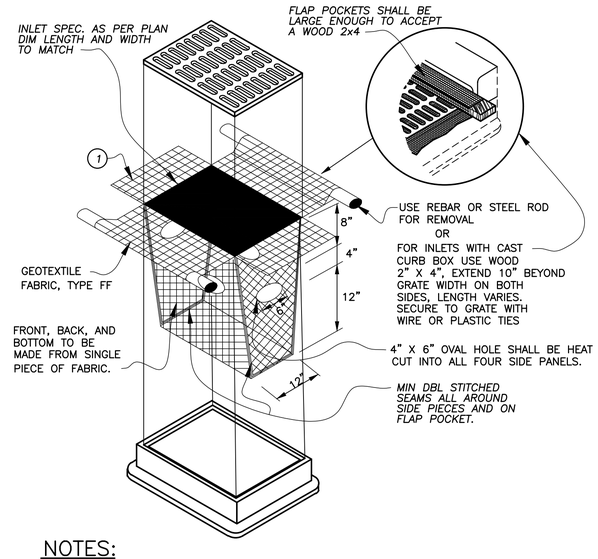


SERVICE PIPE	CORP. STOP	CURB STOP	SERVICE BOX
1"	1"	1"	2 1/2"
1 1/4"	1 1/4"	1 1/4"	3"
1 1/2"	1 1/4"x1 1/2"	1 1/2"	3"
2"	1 1/2"x2"	2"	3"

* FOR A 2" SERVICE PIPE, CORP. STOP FOR A 6" WATER MAIN REQUIRES A TAP WITH A CLAMP.

TAP SERVICE PIPING (COPPER) 02330

NTS

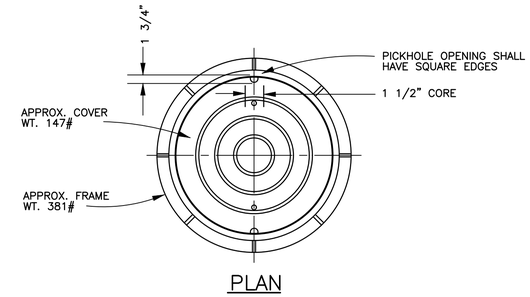


NOTES:

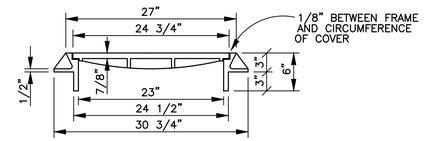
1. FINISHED SIZE, INCLUDING FLAP POCKETS WHERE REQUIRED, SHALL EXTEND A MIN. OF 10" AROUND THE PERIMETER TO FACILITATE MAINTENANCE OR REMOVAL.

INLET PROTECTION TYPE "D" 02544

NTS



PLAN

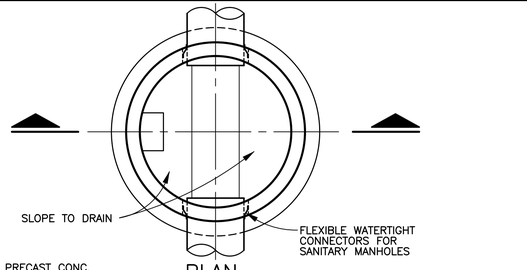


SECTION

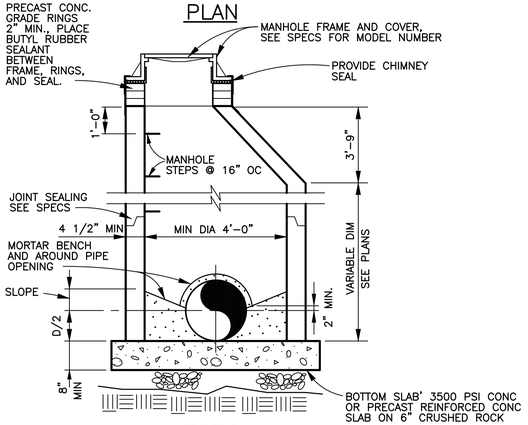
NOTE:
NUMBER OF HOLES IN COVER MAY BE VARIED IN SPECIAL SPECIFICATIONS

STANDARD MANHOLE FRAME & COVER 02551

NTS



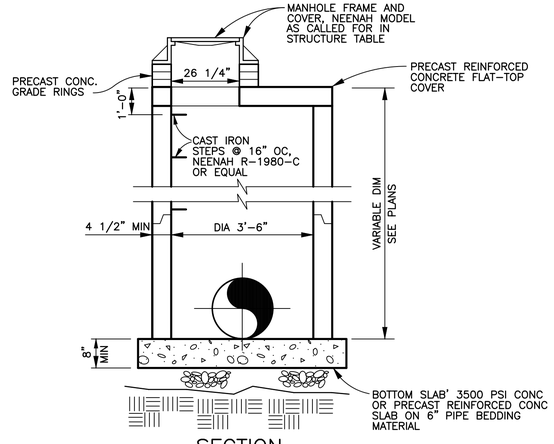
PLAN



SECTION

STANDARD SANITARY MANHOLE 02539

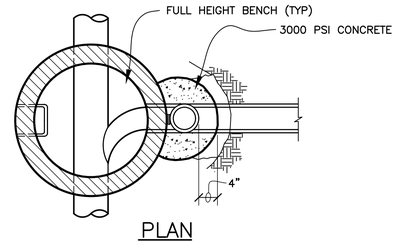
NTS



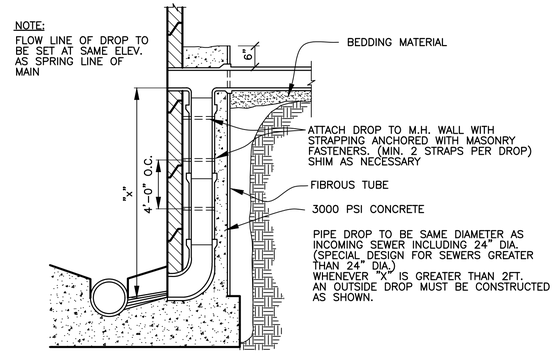
SECTION

STANDARD STORM MANHOLE 02549

NTS



PLAN



SECTION

OUTSIDE DROP CONNECTION 02556

NTS

city of South Milwaukee
Proud Past ... Promising Future

AppliedTechnologies
Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
CIVIL
DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	W.A.H./P.C.G.
DRAWN BY:	P.C.G.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	99-C-2

PSLTSCALE: 1 LTSCALE: 1
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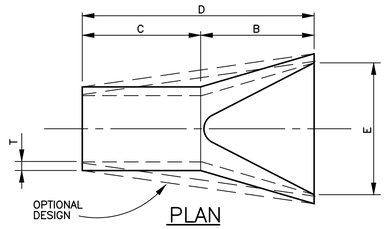
REINFORCED CONCRETE APRON ENDWALLS

PIPE DIA INCH	DIMENSIONS (inches)							APPROX SLOPE
	T	A	B	C	D	E	G	
12	2	4	24	48 7/8	72 7/8	24	2	3 to 1
15	2 1/4	6	27	46	73	30	2 1/4	3 to 1
18	2 1/2	9	27	46	73	36	2 1/2	3 to 1
21	2 1/4	9	36	37 1/2	73 1/2	42	2 3/4	3 to 1
24	3	9 1/2	43 1/2	30	73 1/2	48	3	3 to 1
27	3 1/4	10 1/2	49 1/2	24	73 1/2	54	3 1/4	3 to 1
30	3 1/2	12	54	19 3/4	73 1/2	60	3 1/2	3 to 1
36	4	15	63	34 3/4	97 3/4	72	4	3 to 1
42	4 1/2	21	63	35	98	78	4 1/2	3 to 1
48	5	24	72	26	98	84	5	3 to 1
54	5 1/2	27	65	33 1/4–35 *	98 1/4–100 *	90	5 1/2	2 2/5 to 1
60	6	30–35 *	60	39	99	96	5	2 to 1
65	6 1/2	24–30 *	12–18 *	21–27 *	99	102	5 1/2	2 to 1
72	7	24–36 *	78	21	99	108	6	2 to 1
78	7 1/2	24–36 *	78	21	99	114	6 1/2	2 to 1
84	8	36	91 1/2	21	111 1/2	120	6 1/2	1 1/2 to 1
90	8 1/2	41	87 1/2	24	111 1/2	132	6 1/2	1 1/2 to 1

* MIN–MAX



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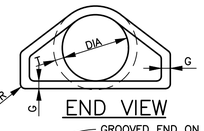
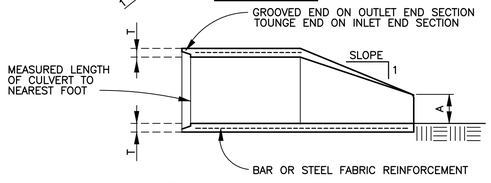


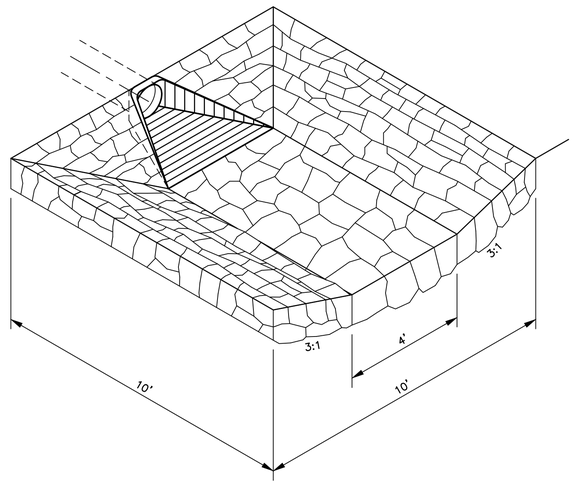
END VIEW



LONGITUDINAL SECTION

CONCRETE ENDWALL 02580

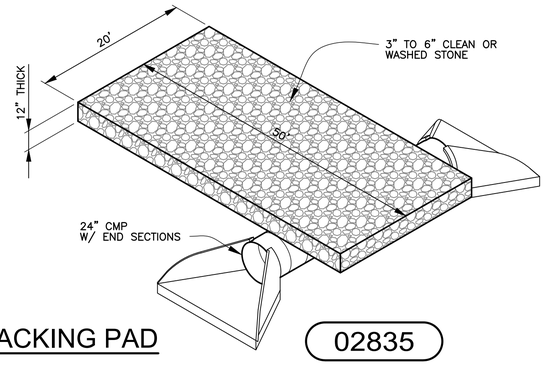
NTS



PRIOR TO PLACEMENT OF RIPRAP, DISCHARGE CHANNEL SHALL BE GRADED AND SHAPED AND LINED WITH PHILIPS 8NP UVX, OR EQUAL. RIPRAP SHALL BE CRUSHED STONE SIZE 6" TO 12" CHINKING AND FILLING VOIDS.

RIPRAP PLACEMENT AT STORM SEWER OUTFALL 02830

NTS



TRACKING PAD 02835

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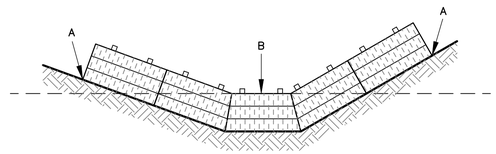


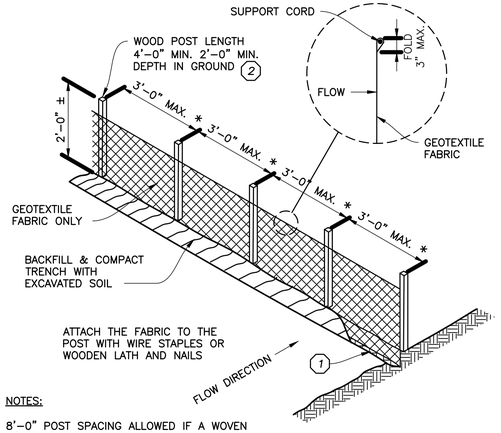
POINTS A SHOULD BE HIGHER THAN POINT B

STRAW BALE BARRIER IN DRAINAGE WAY 02860

NTS

GENERAL NOTES:

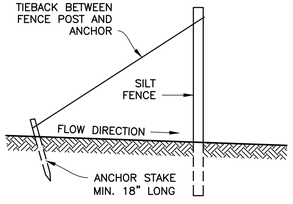
1. TRENCH SHALL BE A MINIMUM OF 4" WIDE & 6" DEEP TO BURY AND ANCHOR THE GEOTEXTILE FABRIC. FOLD MATERIAL TO FIT TRENCH AND BACKFILL & COMPACT TRENCH WITH EXCAVATED SOIL.
2. WOOD POSTS SHALL BE A MINIMUM SIZE OF 1⅛" X 1⅛" OF OAK OR HICKORY.
3. CONSTRUCT SILT FENCE FROM A CONTINUOUS ROLL IF POSSIBLE BY CUTTING LENGTHS TO AVOID JOINTS. IF A JOINT IS NECESSARY USE ONE OF THE FOLLOWING TWO METHODS; A) TWIST METHOD –– OVERLAP THE END POST AND TWIST, OR ROTATE, AT LEAST 180 DEGREES. B) HOOK METHOD –– HOOK THE END OF EACH SILT FENCE LENGTH.
4. DETAILS OF CONSTRUCTION NOT SHOWN SHALL CONFORM TO THE PERTINENT SECTIONS OF THE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS.
5. SILT FENCE SHALL BE INSPECTED WITHIN 24 HOURS AFTER EACH RAINFALL EVENT OR DAILY DURING PROLONGED RAINFALL. REPAIR OR REPLACEMENT (IF NECESSARY) SHALL BE DONE IMMEDIATELY.



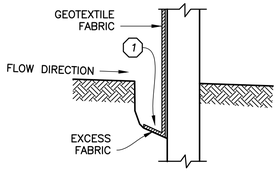
NOTES:

8'–0" POST SPACING ALLOWED IF A WOVEN GEOTEXTILE FABRIC IS USED.

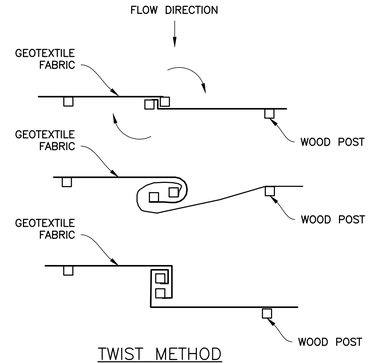
ADDITIONAL POST DEPTH OR TIE BACKS MAY BE REQUIRED IN UNSTABLE SOILS.



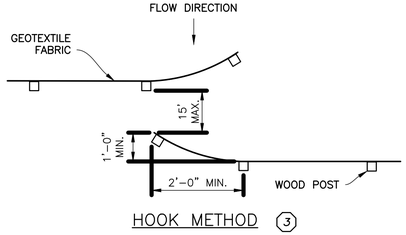
SILT FENCE TIE BACK
(WHEN ADDITIONAL SUPPORT REQUIRED)



TRENCH DETAIL



TWIST METHOD



HOOK METHOD (3)

JOINING TWO LENGTHS OF SILT FENCE

SILT FENCE 02840

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AppliedTechnologies Engineers-Architects

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SOUTH MILWAUKEE, WISCONSIN

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PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

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PSLTSCALE: 1 LTSCALE: 1
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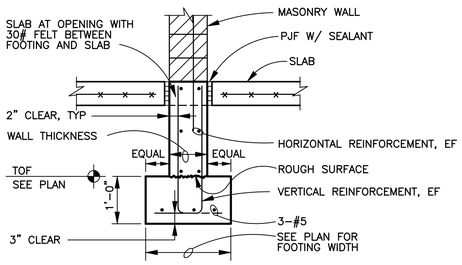
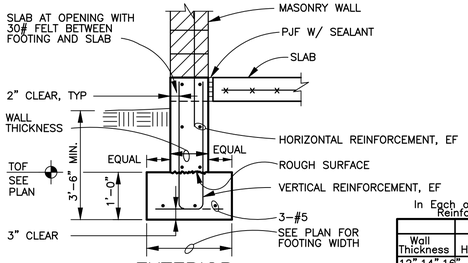


INTERIOR



EXTERIOR

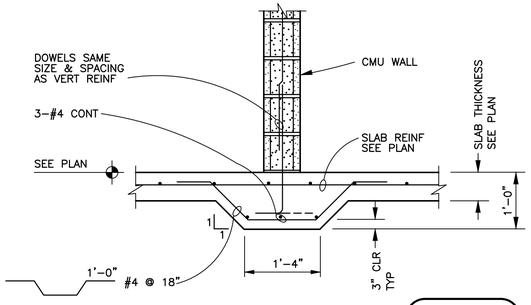
In Each of Two Layers of Reinforcement

Wall Thickness	Reinforcement Horizontal	Reinforcement Vertical
12",14",16"	#5@18"	#4@18
18"	#6@18"	#4@18

STANDARD WALL FOOTING AND FOUNDATION WALL

NTS

03112



THICKENED SLAB

NTS

03120

1. ALL REINFORCEMENT DETAILS SHALL CONFORM TO THE METHODS AND STANDARDS OF ACI 318.
2. UNLESS OTHERWISE SHOWN, CONCRETE WALLS AND SLABS SHALL BE REINFORCED AS FOLLOWS: #4@12" EACH WAY CENTER OF 6" SECTIONS; #5@12" EACH WAY CENTER OF 8" SECTIONS; #4@12" EACH WAY EACH FACE OF 10" SECTIONS; #5@12" EACH WAY EACH FACE OF 12" SECTIONS; SINGLE MAT REINFORCEMENT SHALL BE AT CENTER OF SECTION, UNLESS SHOWN OTHERWISE.
3. CLEARANCE FOR REINFORCEMENT FOR CAST-IN-PLACE CONCRETE UNLESS SHOWN OTHERWISE, SHALL BE WHEN CAST AGAINST GROUND 3" CLEARANCE; FOR SURFACE EXPOSED TO WATER OR WEATHER 1 1/2" CLEARANCE FOR #5 BARS OR SMALLER AND 2" CLEARANCE FOR LARGER BARS; INTERIOR SLABS 3/4" CLEARANCE FOR #11 BARS OR SMALLER; INTERIOR BEAMS AND COLUMNS 1 1/2" CLEARANCE.
4. PLACE HORIZONTAL BARS WITHIN 3" OF TOP AND BOTTOM OF WALLS, UNLESS SHOWN OTHERWISE.
5. REFER TO CORNER AND INTERSECTION REINFORCEMENT DETAILS. IN GENERAL, THE REINFORCEMENT SIZES AND SPACINGS SHALL BE CALLED OUT ON THE PLANS AND REFERENCED TO THESE DETAILS AND THE REINFORCEMENT SHALL LAP WITH THE CORNER AND INTERSECTING REINFORCEMENT.
6. ALL INSIDE DIAMETER OF BENDS, UNLESS OTHERWISE SHOWN, SHALL BE AS DEFINED IN ACI 7.2.
7. UNLESS INDICATED OTHERWISE, CONTRACTOR MAY SPLICE CONTINUOUS SLAB OR LONGITUDE BEAM BARS AT LOCATIONS OF HIS CHOOSING, EXCEPT THAT TOP BAR SPLICES SHALL BE LOCATED AT MIDSPAN AND BOTTOM BAR SPLICES SHALL BE LOCATED AT SUPPORTS.
8. UNLESS OTHERWISE NOTED, ALL WALL REINFORCEMENT BARS SHALL BE CONTINUOUS AROUND CORNERS AND THROUGH COLUMNS OR PILASTERS. REINFORCEMENT SHALL BE EXTENDED INTO CONNECTING WALLS AND LAPPED ON THE OPPOSITE FACE OF THE CONNECTING WALLS. VERTICAL WALL BARS SHALL BE LAPPED WITH DOWELS FROM BASE SLABS AND EXTENDED INTO THE TOP FACE OF ROOF SLABS AND LAPPED WITH TOP SLAB REINFORCEMENT.
9. ROUGH SURFACE-WHEN CONCRETE IS PLACED AGAINST PREVIOUSLY HARDENED CONCRETE, THE INTERFACE SURFACE OF THE HARDEND CONCRETE SHALL BE CLEAN AND FREE OF LAITANCE AND SHALL BE ROUGHENED TO A FULL AMPLITUDE OF 1/4 INCH. THIS CAN BE ACCOMPLISHED BY USING A FORM LINER OR RAKING THE PLASTIC CONCRETE OF THE FIRST POUR OR BY BUSHHAMMERING OR CHISELING HARDENED CONCRETE SURFACES OR ANY OTHER METHOD APPROVED BY THE ENGINEER.
10. ALL REINFORCEMENT DEVELOPMENT LENGTHS, LAP SPLICE LENGTHS, AND HOOK DEVELOPMENT LENGTHS SHALL SATISFY THE FOLLOWING MINIMUM LENGTH REQUIRMENTS:

TENSION DEVELOPMENT LENGTH (INCHES) FY = 60000 PSI				
fc'=	3000	3000	4000	4000
Bar Size	Top	Other	Top	Other
3	22	17	19	15
4	29	22	25	19
5	36	28	31	24
6	43	33	37	29
7	63	48	54	42
8	72	55	62	48
9	81	62	70	54
10	91	70	79	61
11	101	78	87	67
UNCOATED REINFORCEMENT NORMAL WEIGHT CONCRETE TOP BAR, MORE THAN 12" OF CONCRETE CAST BELOW				

TENSION LAP SPLICE LENGTH (INCHES) FY = 60000 PSI				
fc'=	3000	3000	4000	4000
Bar Size	Top	Other	Top	Other
3	28	22	25	19
4	38	29	33	25
5	47	36	41	31
6	56	43	49	37
7	81	63	71	54
8	93	72	81	62
9	105	81	91	70
10	118	91	102	79
11	131	101	114	87
UNCOATED REINFORCEMENT NORMAL WEIGHT CONCRETE TOP BAR, MORE THAN 12" OF CONCRETE CAST BELOW				

COMPRESSION DEVELOPMENT LENGTH (INCHES) FY = 60000 PSI		
fc'=	3000	4000
Bar Size		
3	9	8
4	11	10
5	14	12
6	17	15
7	20	17
8	22	19
9	25	22
10	28	25
11	31	27
ENCLOSED WITHIN SPIRALS OR TIES PER ACI 12.3.3.2		

COMPRESSION LAP SPLICE LENGTH (INCHES) FY = 60000 PSI		
fc'=	< 3000	>=3000
Bar Size		
3	15	12
4	20	15
5	25	19
6	30	23
7	35	27
8	40	30
9	46	34
10	51	39
11	57	43

TENSION HOOK DEVELOPMENT LENGTH (INCHES) FY = 60000 PSI		
fc'=	3000	4000
Bar Size		
3	6	6
4	8	7
5	10	9
6	12	10
7	14	12
8	16	14
9	18	15
10	20	17
11	22	19
UNCOATED REINFORCEMENT NORMAL WEIGHT CONCRETE FOR <=#11, SIDE COVER >=2.5" FOR 90° HOOK, TAIL COVER >=2"		

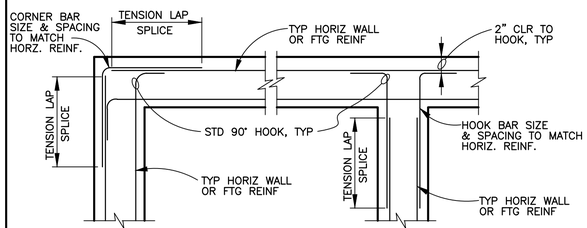
FOR LIGHTWEIGHT AGGREGATE CONCRETE, INCREASE TENSION DEVELOPMENT LENGTH, TENSION LAP SPLICE LENGTH, AND TENSION HOOK DEVELOPMENT LENGTH BY 30%.

FOR EPOXY COATED REINFORCEMENT; INCREASE TENSION DEVELOPMENT LENGTH AND TENSION LAP SPLICE LENGTH BY 50%, AND INCREASE TENSION HOOK DEVELOPMENT LENGTH BY 20%.

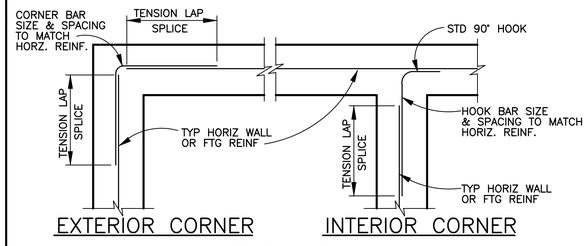
GENERAL REINFORCEMENT NOTES

NTS

03201



DOUBLE MAT



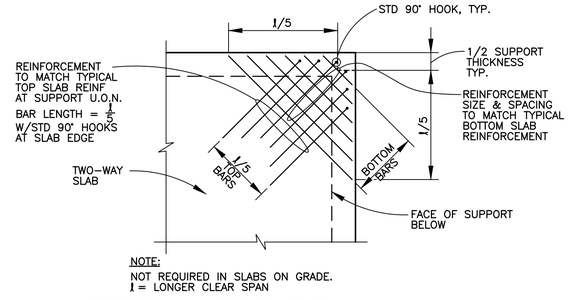
SINGLE MAT

NOTE:
"TENSION LAP SPLICE LENGTH" PER TABLE IN THE GENERAL REINFORCMENT NOTES (03201) . ALL SPLICE BARS TO BE SAME SIZE AND SPACING AS TYPICAL HORIZ REINF UON.

CORNER REINFORCEMENT FOR WALLS AND FOOTINGS

03205

NTS



NOTE:
NOT REQUIRED IN SLABS ON GRADE.
1 = LONGER CLEAR SPAN

SPECIAL CORNER REINFORCEMENT

03207

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APPROVED BY: W.A.E.
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 99-AS-1

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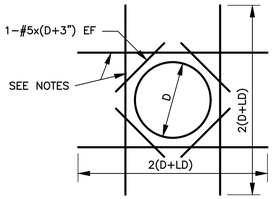
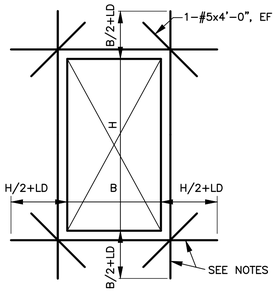


CIRCULAR OPENING



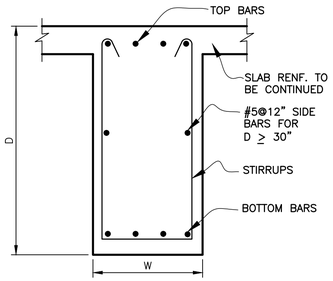
RECTANGULAR OPENING

NOTES:

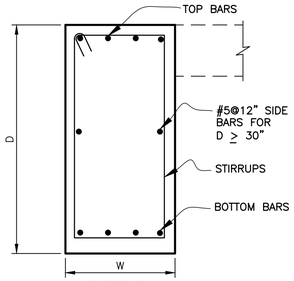
1. THESE DETAILS APPLY TO ALL OPENINGS IN CONCRETE WALLS AND SLABS WHEN LARGEST OPENING DIMENSION IS GREATER THAN TWO TIMES THE SECTION THICKNESS OR GREATER THAN REINFORCEMENT SPACING IN THE SECTION, UNLESS OTHERWISE INDICATED IN THE DRAWINGS.
2. THE AREA OF ADDITIONAL REINFORCEMENT REQUIRED IN EACH FACE ON EACH SIDE OF AN OPENING SHALL EQUAL OR EXCEED ONE–HALF OF THE AREA OF THE INTERCEPTED BARS IN EACH FACE, IN EACH DIRECTION, RESPECTIVELY WITH A MINIMUM OF 1–#5 BAR EACH FACE.
3. THE ADDITIONAL REINFORCEMENT ALONG AN EDGE MAY BE OMITTED WHEN THAT THAT EDGE IS SUPPORTED BY A BEAM.
4. PLACE THE ADDED BARS IN THE SAME LAYERS AS THE WALL OR SLAB REINFORCEMENT
5. LD = TENSION DEVELOPMENT LENGTH OR EXTENDED AS FAR AS POSSIBLE WITH STD HOOK AT END. SEE (03201)

OPENING REINFORCEMENT (03210)

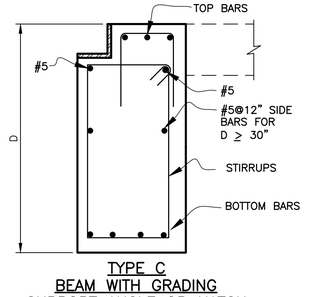
NTS



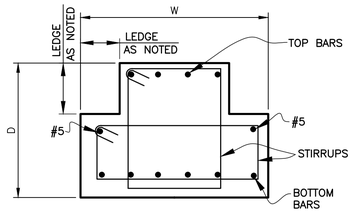
TYPE A
BEAM WITH SLAB



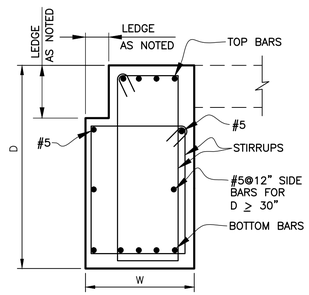
TYPE B
BEAM WITHOUT SLAB OR EDGE BEAM



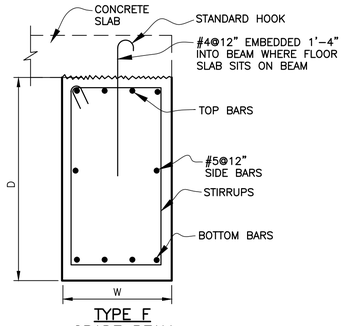
TYPE C
BEAM WITH GRADING SUPPORT ANGLE OR HATCH FRAME



TYPE D
LEDGE BEAM FOR PRECAST CONCRETE PLANK



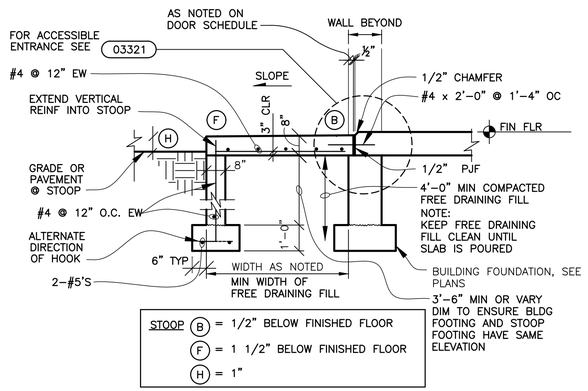
TYPE E
BEAM WITH LEDGE OR BEAM SEAT



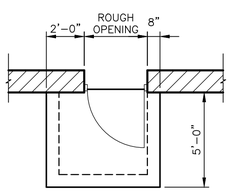
TYPE F
GRADE BEAM

TYPICAL BEAM SECTIONS (03450)

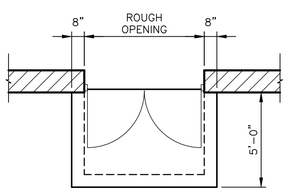
NTS



TYP STOOP SECTION



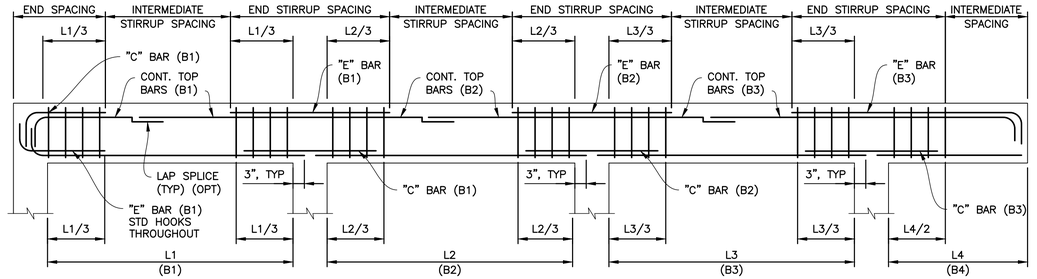
STOOP PLAN AT SERVICE DOOR



STOOP PLAN AT DOUBLE SERVICE DOOR

STOOP W/ FROST FOOTING (03319)

NTS



NOTES:
1. WHERE POSSIBLE EXTEND TOP BARS INTO SLAB TO DEVELOP FULL LAP LENGTH.
2. WHEN BEAMS INTERSECT OTHER BEAMS, PROVIDE EITHER STANDARD HOOKS TO OPPOSITE FACE OF BEAM, OR PROVIDE MATCHING CORNER BARS WITH FULL LAP LENGTH, SEE TYPICAL BEAM REINFORCING PLACEMENT DETAIL.

BARS IN MULTIPLE LAYERS SHALL HAVE MINIMUM 1 1/2" CLEAR BETWEEN LAYERS.
"C" – ADDITIONAL BOTTOM BARS IN SINGLE OR MULTIPLE LAYERS.
"E" – ADDITIONAL TOP BARS IN SINGLE OR MULTIPLE LAYERS.

TYPICAL CONCRETE BEAM PROFILE AND LAYOUT (03452)

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STANDARD DETAILS
ARCHITECTURAL/STRUCTURAL
DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	J.P.G./B.A.G.
DRAWN BY:	J.T.H.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	99-AS-2

PSLTSCALE: 1 LTSCALE: 1
J:\5795 – S Mke\GRAPHICS\DRAWINGS\99–AS–2 DETAILS.dwg Last Modified: 12 February 2018 Plotted On: 4/16/2018 2:41 PM by PHIL GERLACH
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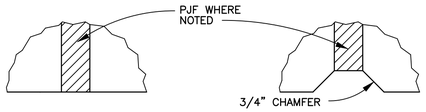
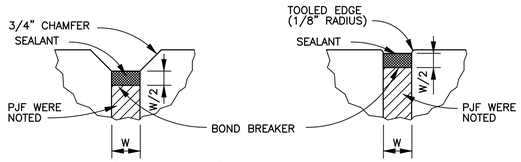


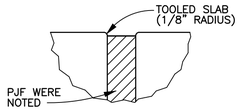
SLAB OR WALL AGAINST EARTH

INTERIOR WALL OR BOTTOM OF SLAB

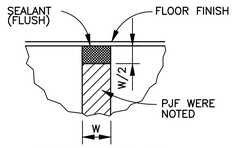


TANK (WET SIDE) OR EXTERIOR SIDE OF EXPOSED WALL

TANK OR FLOOR SLAB WITH SEALANT



FLOOR SLAB WITHOUT SEALANT



FLOOR SLAB WITH FLOOR FINISH

JOINT TREATMENT DETAILS 03500

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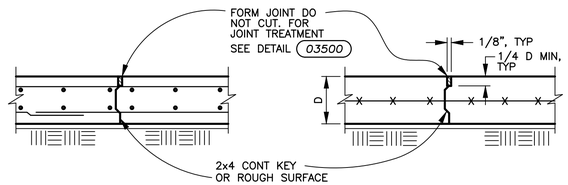


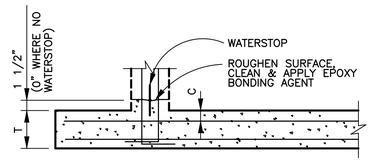
REINFORCING BARS

WELDED WIRE FABRIC

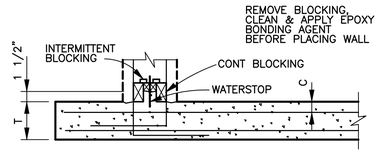
NOTE:
IF CONSTRUCTION JOINT OCCURS AT A CONTROL JOINT, CONTINUE ALTERNATE BARS/WIRES ACROSS JOINT INTO SECOND POUR FOR TENSION DEVELOPMENT LENGTH. SEE DETAIL 03201

SLAB ON GRADE CONSTRUCTION JOINTS 03501

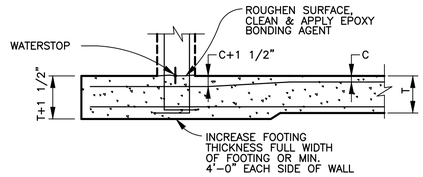
NTS



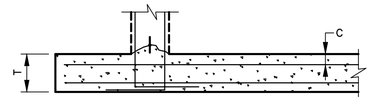
TYPICAL BASE



ALTERNATE BASE



ALTERNATE BASE

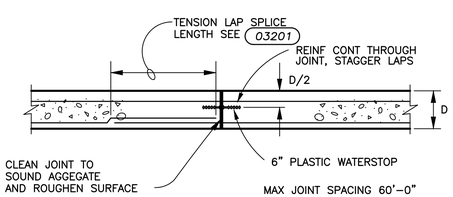


UNACCEPTABLE BASE

NOTES:
1. C-MINIMUM CLEARANCE FOR REINFORCING BARS, SEE GENERAL REINFORCEMENT NOTES 03201
2. T-FOOTING THICKNESS.
3. WHEN USING ALTERNATE BASE INCREASE DOWEL BARS TO PROVIDE SAME LAP LENGTH AS TYPICAL BASE.
4. SUPPORT WATERSTOP AT 3'-0" OC

WALL- BASE SLAB CONSTRUCTION JOINT 03505

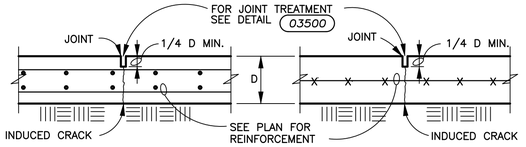
NTS



PLAN

VERTICAL CONTROL AND CONSTRUCTION JOINT 03506

NTS



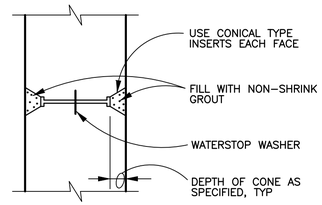
REINFORCING BARS

WELDED WIRE FABRIC

NOTE:
1. IF CONTRACTOR ELECTS TO SAWCUT JOINT, THE CUT SHALL BE MADE WITHIN 6-12 HOURS AFTER PLACING CONCRETE.
2. CONTINUE WWF ACROSS JOINT, CUT ALTERNATE WIRES ACROSS JOINT BACK 3" EACH SIDE OF JOINT.
3. CONTINUE BARS ACROSS JOINT, CUT ALTERNATE BARS ACROSS JOINT BACK 3" EACH SIDE OF JOINT.
4. CONSTRUCTION JOINT MAY BE SUBSTITUTED FOR CONTROL JOINT. SEE DETAIL 03501 .

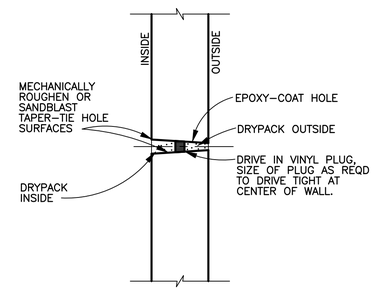
SLAB ON GRADE CONTROL JOINTS 03510

NTS



FORM SNAP-TIE HOLE 03560

NTS



NOTE:
MINIMUM DIAMETER AT OUTSIDE = 1"
TAPER HOLE SO THAT MINIMUM INSIDE DIAMETER = 1 1/4"

CONSTRUCTION STEPS:
1. SANDBLAST OR MECHANICALLY ROUGHEN.
2. DRIVE IN VINYL PLUG.
3. EPOXY COAT INSIDE AND WHILE EPOXY IS TACKY DRYPACK INSIDE.
4. EPOXY COAT OUTSIDE AND WHILE EPOXY IS TACKY DRYPACK OUTSIDE. USE NONMETALIC NONSHRINK GROUT AS SPECIFIED.

ALTERNATE FORM TIE-THROUGH BOLT 03561

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STANDARD DETAILS
ARCHITECTURAL/STRUCTURAL DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

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DRAWN BY:	J.T.H.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	99-AS-3

PSLTSCALE: 1 LTSCALE: 1
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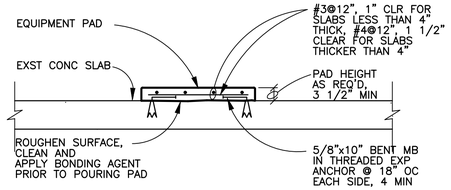
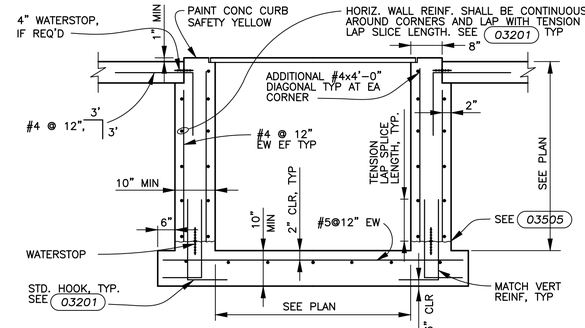
1. PAD SIZE SHALL BE MINIMUM SHOWN ON PLANS OR AS SPECIFIED BY THE MANUFACTURER AND APPROVED BY THE ENGINEER.
2. THE SIZE, NUMBER, TYPE, LOCATION AND THREAD PROJECTION OF THE ANCHOR BOLTS SHALL BE AS SPECIFIED BY THE EQUIPMENT MANUFACTURER.
3. BOLTS SHALL BE HELD IN POSITION WITH A TEMPLATE WHILE PAD IS BEING POURED.
4. ANCHOR BOLT SLEEVES SHALL BE AS DETAILED IN (03602) .
5. EQUIPMENT BASES SHALL BE INSTALLED LEVEL UNLESS SPECIFIED OTHERWISE.
6. WEDGES OR SHIMS SHALL BE USED TO SUPPORT THE BASE WHILE THE NON-SHRINK GROUT IS PLACED. TEMPORARY LEVELING NUTS SHALL BE BACKED OFF. IF LEFT IN, THE WEDGES OR SHIMS SHALL NOT BE EXPOSED TO VIEW.

EQUIPMENT PAD NOTES 03601



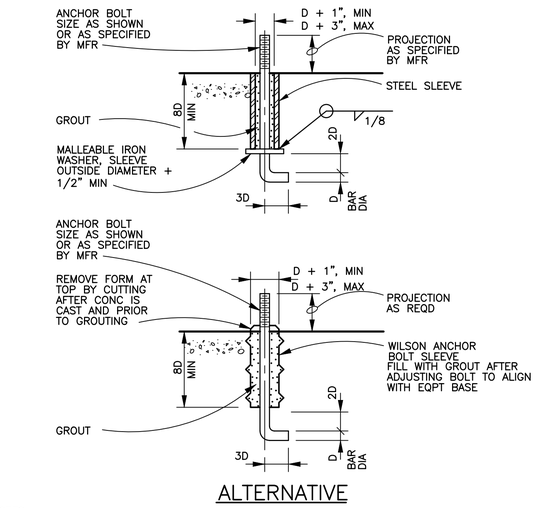
NOTE:
SEE EQUIPMENT PAD NOTES (03601)

EQUIPMENT PAD 03617



NTS

RECTANGULAR SUMP DETAIL 03850



ALTERNATIVE

NOTES:

1. THE SIZE, NUMBER, TYPE, LOCATION AND THREAD PROJECTION OF THE ANCHOR BOLTS SHALL BE AS SPECIFIED BY THE EQUIPMENT MANUFACTURER.
2. BOLTS SHALL BE HELD IN POSITION WITH A TEMPLATE WHILE PAD IS BEING POURED.
3. ANCHOR BOLT SLEEVES SHALL BE USED TO PROVIDE THE ANCHOR BOLT A MINIMUM ADJUSTMENT OF 1/2" IN ALL DIRECTIONS.
4. THE MINIMUM SLEEVE LENGTH SHALL BE 8 TIMES THE BOLT DIAMETER. SLEEVES SHALL HAVE A MINIMUM INTERNAL DIAMETER 1" GREATER THAN BOLT DIAMETER AND A MAXIMUM INTERNAL DIAMETER 3" GREATER THAN ANCHOR BOLT DIAMETER.
5. SLEEVES SHALL BE FILLED WITH NON-SHRINK GROUT AFTER ADJUSTMENTS ARE COMPLETED.

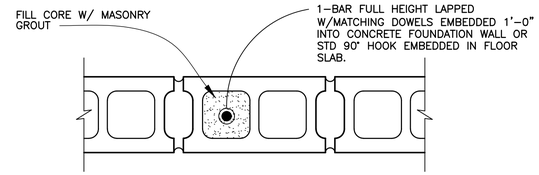
SLEEVED ANCHOR BOLT 03602

NTS

D=PIPE OUTSIDE DIAMETER	T= SUPPORT THICKNESS	H= MAXIMUM HEIGHT	REINFORCEMENT		
			NUMBER OF LAYERS	HORIZONTAL	VERTICAL
D≤24"	8"	40"	1 LAYER	#4@12"	#4@18"
24"<D≤42"	10"	50"	1 LAYER	#5@12"	#5@18"
42"<D	12"	60"	2 LAYERS	#5@18"	#4@18"

CONCRETE SUPPORT FOR PIPE 03760

NTS

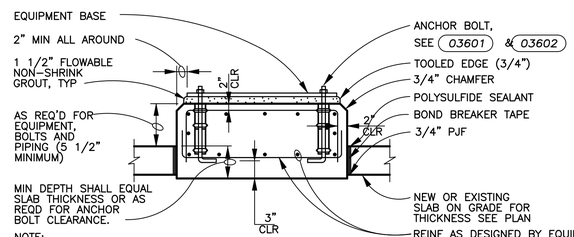


NOTES:

1. DEFORMED BAR REINFORCEMENT SIZE AND SPACING AS NOTED ON PLANS.
2. VERTICAL WALL REINFORCING IS TO BE EMBEDDED 6" INTO BOND BEAM AT TOP OF WALL.
3. ALL LAP SPLICES TO BE 48 BAR DIAMETERS.
4. HORIZONTAL JOINT REINFORCING AT 16" OC, TRUSS TYPE, HOT DIPPED GALVANIZED 3/16" DIAMETER. U.O.N.
5. DOWELS MAY BE DRILLED AND EPOXIED INTO FOUNDATION OR SLAB. MIN 6" EMBEDMENT

REINFORCED MASONRY DETAIL 04003

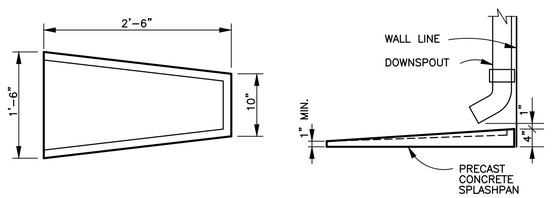
NTS



NOTE:
1. SEE EQUIPMENT BASE NOTES (03601) .
2. MASS OF CONC PAD SHALL BE EQUAL TO 10 TIMES THE ROTATING MASS OF THE EQPT OR 3 TIMES THE GROSS MASS OF THE MACHINE, WHICHEVER IS GREATER.

EQUIPMENT PAD 03614

NTS



PLAN ELEVATION

SPLASH PAN DETAIL 03810

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PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 99-AS-4

PLSTSCALE: 1 LTSCALE: 1
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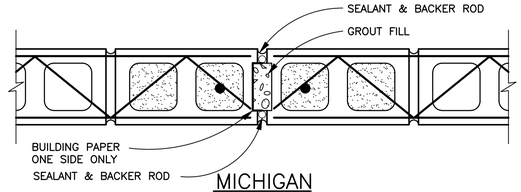
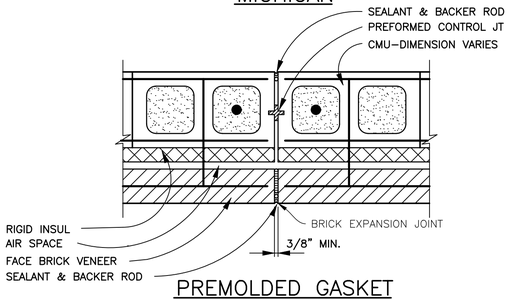
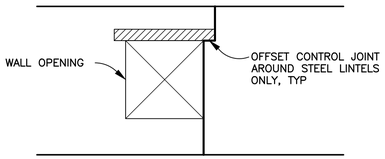


MICHIGAN



PREMOLDED GASKET



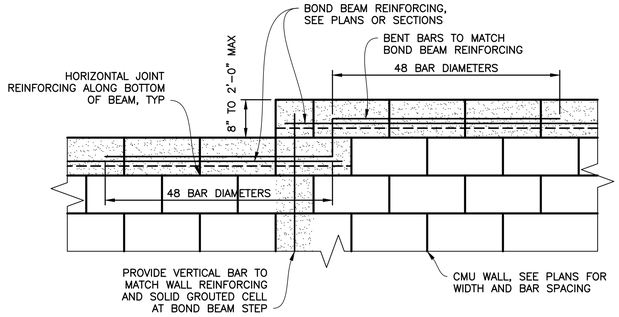
ELEVATION

NOTES:

1. TERMINATE HORIZ REINF EACH SIDE OF JOINT. PROVIDE ONE REINFORCED AND GROUTED VERTICAL CELLS ON EACH SIDE OF JOINT. BOND BEAM REINF AT ROOF SHALL BE CONT THROUGH CONTROL JOINT.
2. SPECIAL CONTROL JOINT CMU CAN ALSO BE USED.

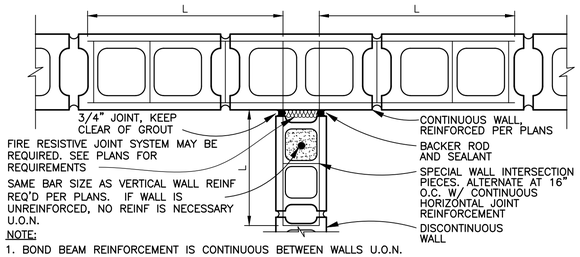
CONTROL JOINT DETAIL 04010

NTS



STEPPED BOND BEAM 04410

NTS

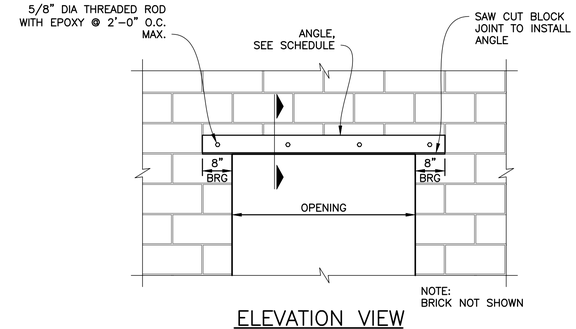


NOTE:

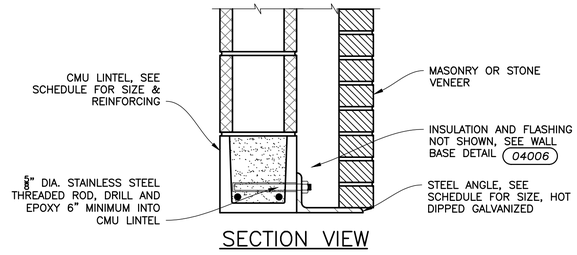
1. BOND BEAM REINFORCEMENT IS CONTINUOUS BETWEEN WALLS U.O.N.
2. MATCHING DOWEL W/ STD 90° HOOK EMBEDDED IN SLAB OR STRAIGHT DOWEL GROUTED WITH 6" EMBEDMENT INTO SLAB. REQUIRED AT EACH REINFORCED CELL.
3. L=2'–6" MIN FOR EXTERIOR OR INTERIOR LOAD BEARING WALL. L=1'–4" MIN FOR NON LOAD BEARING WALL.

MASONRY WALL INTERSECTION DETAIL 04551

NTS



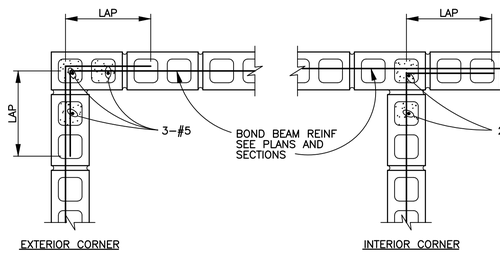
ELEVATION VIEW



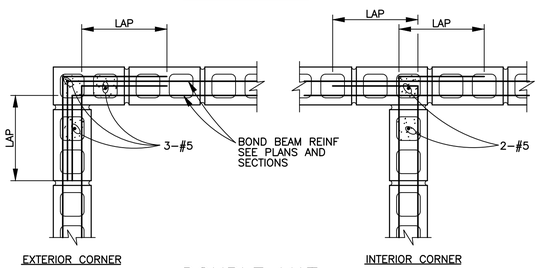
SECTION VIEW

BRICK SUPPORT ANGLE FOR CMU LINTEL 04566

NTS



SINGLE MAT



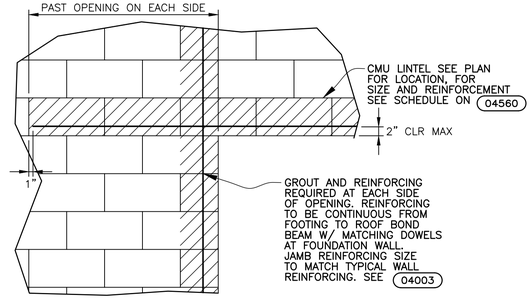
DOUBLE MAT

NOTE:

1. LAP=37 BAR DIAMETERS OR 2'–0" MINIMUM UNLESS NOTED OTHERWISE.
2. GROUT ALL VERT CELLS HAVING REINFORCEMENT.
3. REINFORCE JOINT CORNERS AND INTERSECTIONS WITH STRAP ANCHORS AT 16" OC.

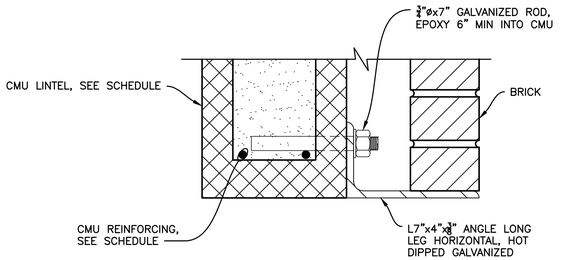
BLOCK WALL CORNERS REINF 04550

NTS



CMU LINTEL BEARING 04564

NTS



CMU LINTEL BRICK SUPPORT 04567

NTS

city of South Milwaukee — Proud Past ... Promising Future

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

Applied Technologies Engineers-Architects

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
ARCHITECTURAL/STRUCTURAL
DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	J.P.G./B.A.G.
DRAWN BY:	J.T.H.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	99-AS-5

PSLTSCALE: 1 LTSCALE: 1
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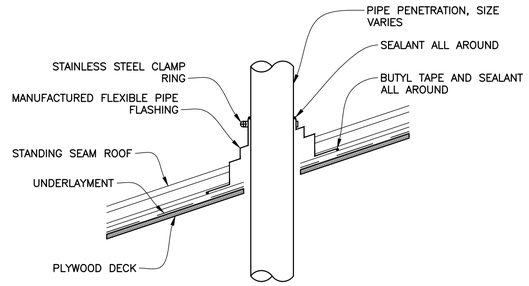
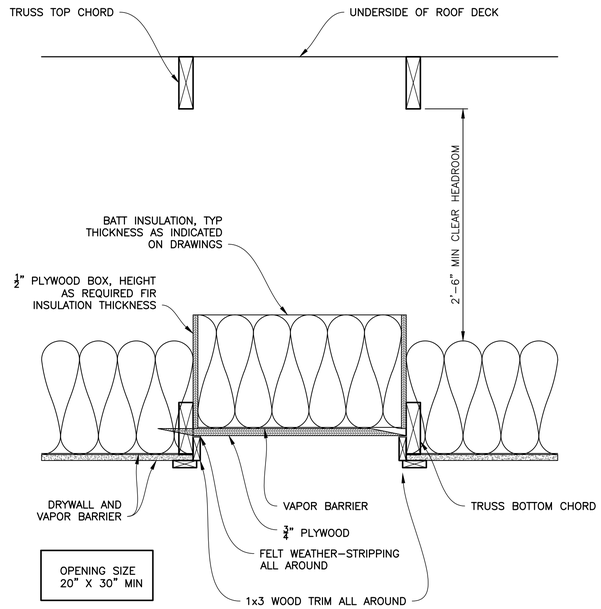


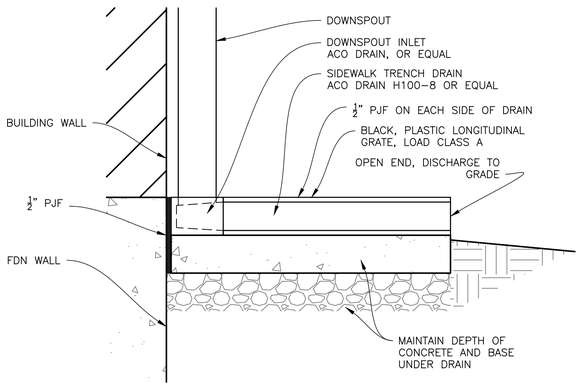
ROOF PENETRATION 07616

NTS



ATTIC ACCESS PANEL 08700

NTS



DOWNSPOUT AT SIDEWALK TRENCH DRAIN 07905

NTS

city of South Milwaukee
Proud Past ... Promising Future

Applied Technologies
Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
DISCIPLINE DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: .
DRAWN BY: .
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 99-AS-6

PSLTSCALE: 1 LTSCALE: 1
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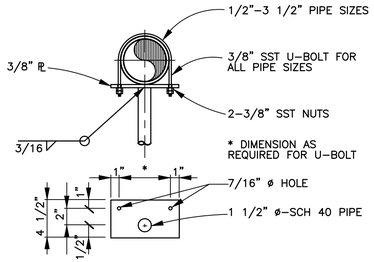
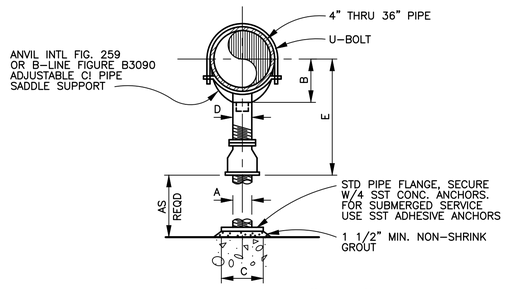
PIPE SIZE	A	B	C	D	E MIN	E MAX
2-1/2"	2-1/2"	3-1/2"	9"	1-1/2"	8"	13"
3"	2-1/2"	3-3/4"	9"	1-1/2"	8-1/4"	13-1/4"
3-1/2"	2-1/2"	4"	9"	1-1/2"	8-1/2"	13-1/2"
4"	3"	4-1/4"	9"	2-1/2"	9-1/4"	14"
5"	3"	4-7/8"	9"	2-1/2"	10"	14-3/4"
6"	3"	5-1/2"	9"	2-1/2"	10-1/2"	15-1/4"
8"	3"	6-7/8"	9"	2-1/2"	11-3/4"	16-1/2"
10"	3"	8-1/2"	9"	2-1/2"	13-1/2"	18-1/4"
12"	3"	9-15/16"	9"	2-1/2"	15"	19-3/4"
14"	4"	10-15/16"	11"	3"	16-1/4"	20-3/4"
16"	4"	12-3/8"	11"	3"	17-3/4"	22-1/4"
18"	6"	13-7/8"	13-1/2"	3-1/2"	19-1/4"	24"
20"	6"	15-3/8"	13-1/2"	3-1/2"	21"	25-1/2"
24"	6"	17-15/16"	13-1/2"	4"	23-3/4"	28-1/4"
30"	6"	21-5/16"	13-1/2"	4"	27"	31-1/2"
32"	6"	22-1/2"	13-1/2"	4"	28-1/4"	32-3/4"
36"	6"	24-1/2"	13-1/2"	4"	30-1/4"	34-3/4"



PIPE SIZES 1/2"–3 1/2"



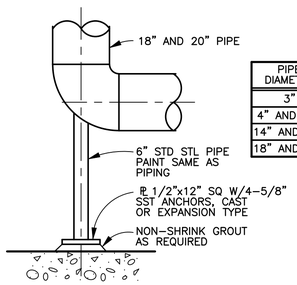
PIPE SIZES 4"–36"

NOTES

1. PROVIDE HALF ROUND RIGID INSULATION AND INSULATION PROTECTION SHIELD, SIMILAR TO ANVIL INTL FIG. 167 OR ELCEN FIG. 219, WHERE PIPING IS INSULATED.
2. PROVIDE NEOPRENE WAFFLE ISOLATION PAD, SIMILAR TO MASON TYPE "W" OR KORFUND KORPAD 40, UNDER SUPPPORT FOOT WHEN PIPING IS ISOLATED OR SUPPORT IS ADJACENT TO MECHANICAL EQUIPMENT.
3. PIPING SUPPORTS TO RECIEVE SAME PAINT SYSTEM AS PIPING

PIPE SUPPORT 15100

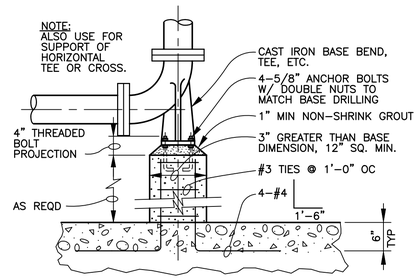
NTS



PIPE DIAMETER	SUPPORT DIAMETER	PLATE THICKNESS	ANCHOR BOLT DIA
3"	2 1/2"	3/8"	3/8"
4" AND 12"	3"	3/8"	1/2"
14" AND 16"	4"	3/8"	1/2"
18" AND 20"	6"	1/2"	5/8"

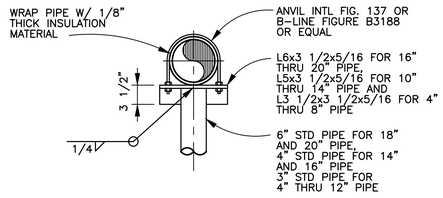
PIPE SUPPORT 15101

NTS



BASE BEND DETAIL 15102

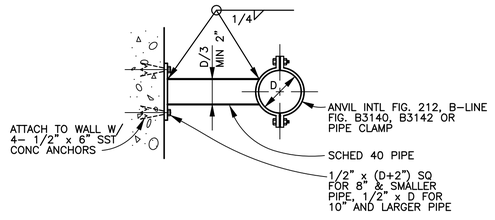
NTS



NOTE:
USE STANDARD AWWA RING FLANGE FOR BASE.

PIPE SUPPORT 15103

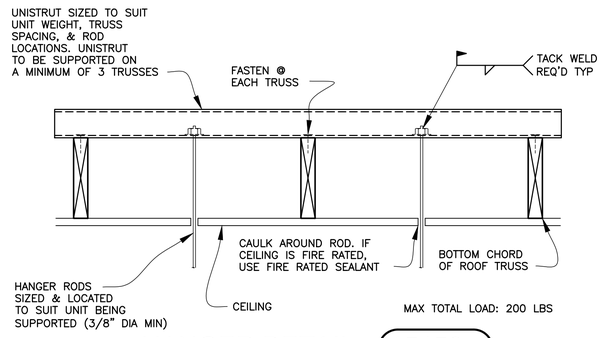
NTS



PLAN

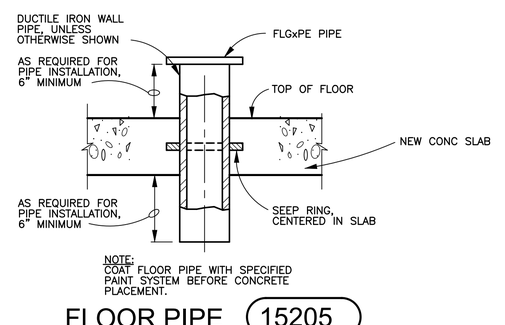
PIPE SWAY BRACE 15140

NTS



HANGER DETAIL 15156

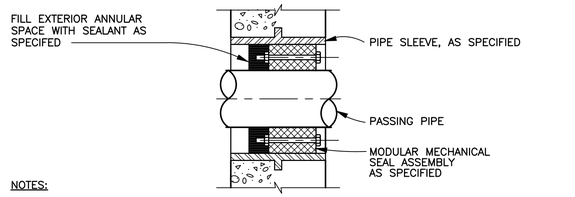
NTS



NOTE:
COAT FLOOR PIPE WITH SPECIFIED PAINT SYSTEM BEFORE CONCRETE PLACEMENT.

FLOOR PIPE 15205

NTS

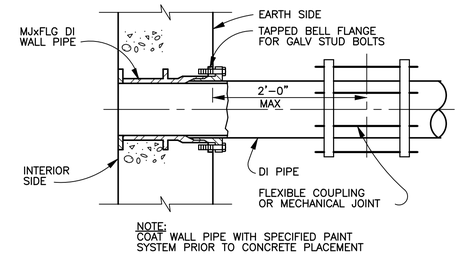


NOTES:

1. CORE DRILLED HOLE WITHOUT SLEEVE PERMITTED IN PRECAST CONCRETE OR EXISTING CONCRETE.
2. COAT WALL SLEEVE WITH SPECIFIED PAINT SYSTEM BEFORE CONCRETE PLACEMENT.
3. INSTALL MODULAR MECHANICAL SEAL ASSEMBLY IN WALL WITH ADJUSTMENT BOLT HEADS FACING INTO INTERIOR SPACES WHEN POSSIBLE FOR FUTURE ADJUSTMENT.
4. FOR FIRE–RATED CONSTRUCTION. INSTALL MODULAR MECHANICAL SEAL ASSEMBLY(IES) AS SPECIFIED FOR REQUIRED FIRE RATING.

WALL PENETRATION SEAL 15221

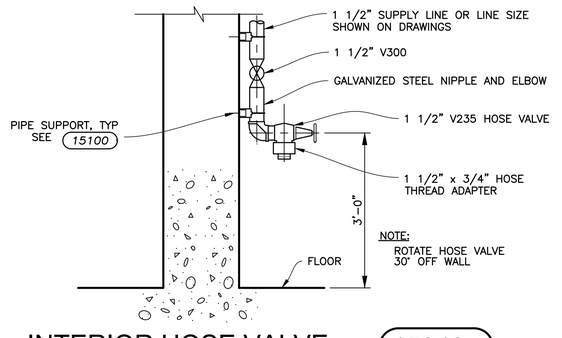
NTS



NOTE:
COAT WALL PIPE WITH SPECIFIED PAINT SYSTEM PRIOR TO CONCRETE PLACEMENT

WALL PIPE 15223

NTS



INTERIOR HOSE VALVE 15340

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city of South Milwaukee — Proud Past ... Promising Future

AppliedTechnologies Engineers-Architects

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	APVD

CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
MECHANICAL
DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.
PROJECT NO. 5795
DATE APRIL 2018
DRAWING NO. 99-M-1

PSLTSCALE: 1 LTSCALE: 1
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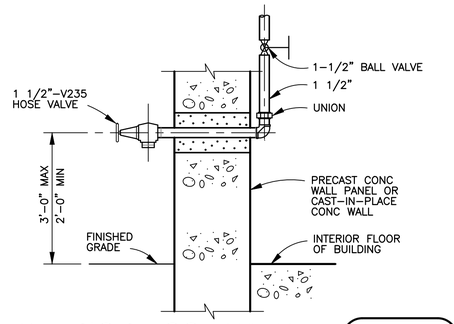

EXTERIOR HOSE VALVE 15352

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AppliedTechnologies
Engineers-Architects

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IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
MECHANICAL
DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1"
ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST
SCALE(S) ACCORDINGLY

DESIGNED BY: K.R.H.
DRAWN BY: J.C.S.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO.
5795

DATE
APRIL 2018

DRAWING NO.
99-M-2

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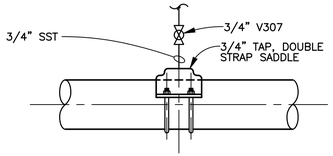
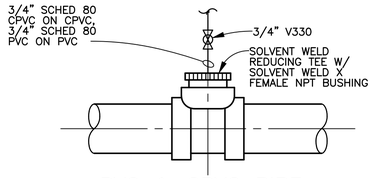
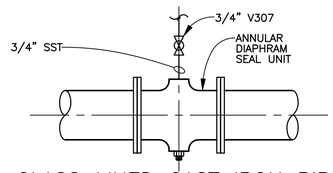


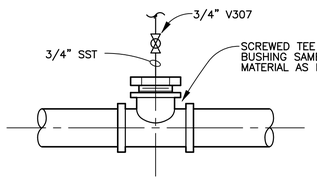
CEMENT LINED STEEL PIPE,
CAST IRON PIPE & DUCTILE IRON PIPE



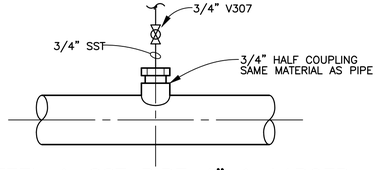
PVC & CPVC PIPE



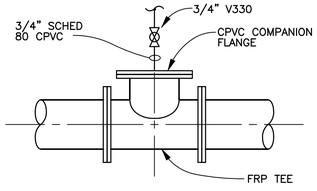
GLASS LINED CAST IRON PIPE



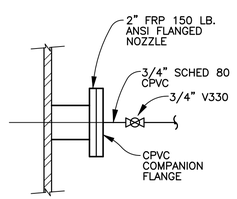
STEEL & SST PIPE 3-1/2" & SMALLER



STEEL & SST PIPE 4" & LARGER



FRP PIPE

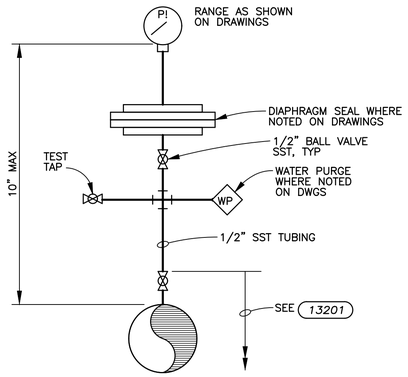


FRP TANK

PRESSURE INDICATOR INSTALLATION

NTS

13222

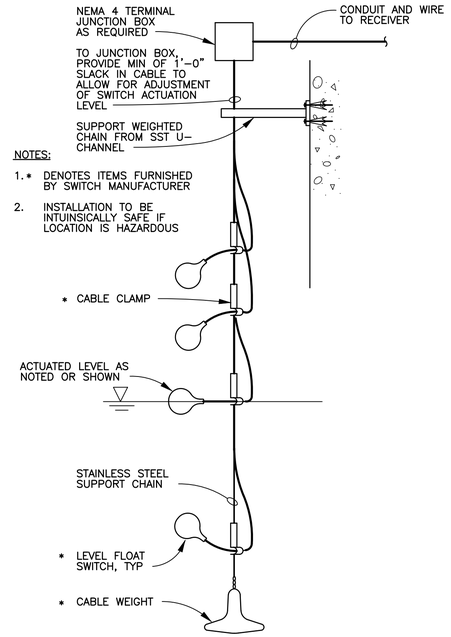


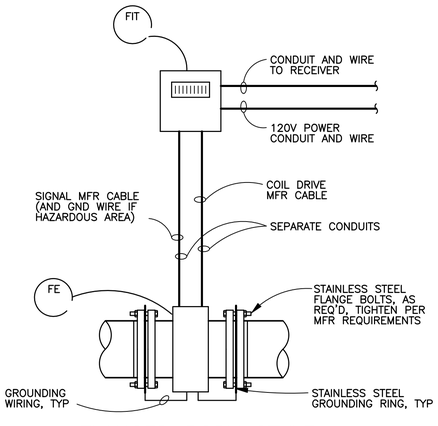
DIRECT MOUNTING

FLOAT TYPE LEVEL SWITCH INSTALLATION

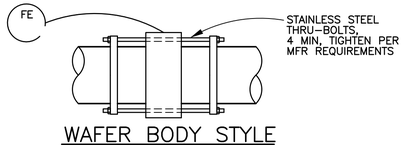
NTS

13362





FLANGED BODY STYLE

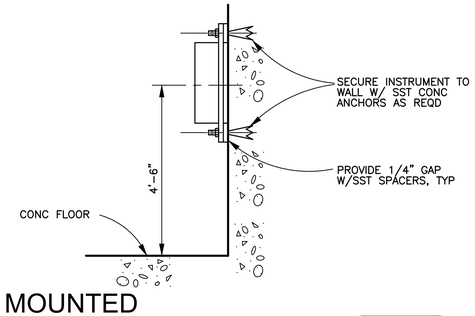


WAFER BODY STYLE

INLINE PRIMARY ELEMENT INSTALLATION - MAGMETER-REMOTE TRANSMITTER

NTS

13260



WALL MOUNTED INSTRUMENT INSTALLATION

13415

PRESSURE CONNECTION INSTALLATION DETAILS

NTS

13201

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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION
IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
INSTRUMENTATION & CONTROL
DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	K.R.H.
DRAWN BY:	J.T.H./P.C.G.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	99-I-1

PSLTSCALE: 1 LTSCALE: 1
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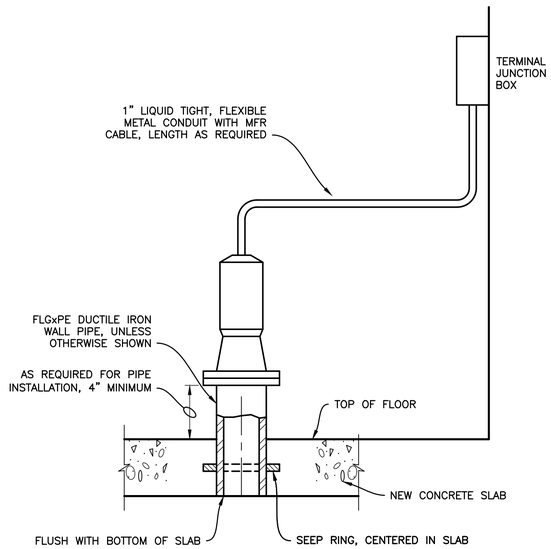
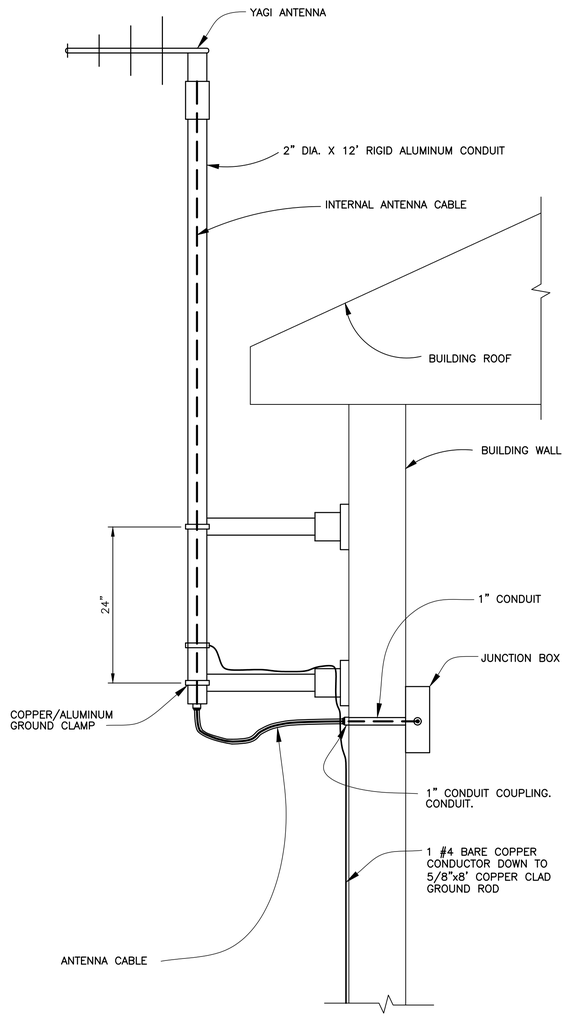


NOTE:
COAT FLOOR PIPE WITH SPECIFIED PAINT SYSTEM BEFORE CONCRETE PLACEMENT.

ULTRASONIC LEVEL SENSOR FLANGE MOUNT

NTS

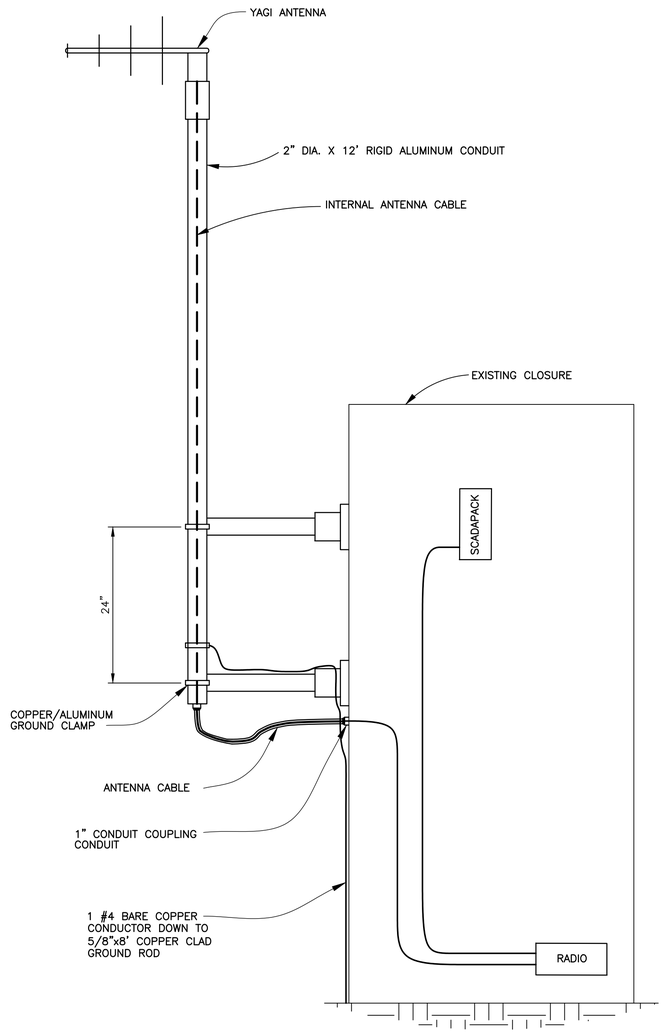
13706



BUILDING MOUNTED ANTENNA

NTS

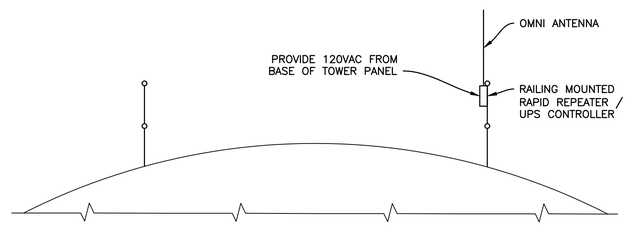
13960



ENCLOSURE MOUNTED ANTENNA

NTS

13961



WATER TOWER MOUNTED REPEATER

NTS

13962

city of South Milwaukee
Proud Past... Promising Future

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Engineers-Architects

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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
INSTRUMENTATION & CONTROL DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY:	K.R.H.
DRAWN BY:	P.C.G.
CHECKED BY:	F.X.T.
APPROVED BY:	W.A.E.
PROJECT NO.	5795
DATE	APRIL 2018
DRAWING NO.	99-I-2

PSLTSCALE: 1 LTSCALE: 1
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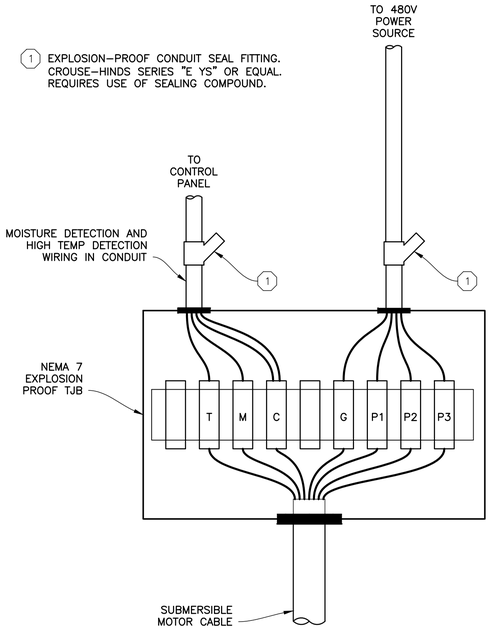
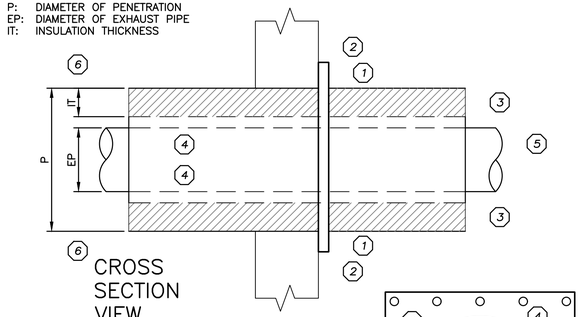


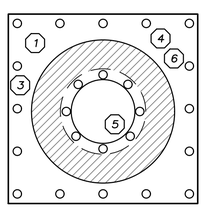
SUBMERSIBLE MOTOR CABLE SPLITTING DIAGRAM, HAZARDOUS LOCATION APPLICATION

16261

NTS



CROSS SECTION VIEW



BUILDING EXTERIOR VIEW

GENERAL NOTES:
1. THIMBLE INSTALLATION AND MATERIALS SHALL COMPLY WITH NFPA 37 CHAPTER 7.

KEYED NOTES:

1. MOUNTING PLATE, BOLT ASSEMBLY TO EXTERIOR SURFACE OUTSIDE.
2. EXTERIOR SURFACE. FRAME AS REQ'D TO PREPARE FOR MOUNTING PLATE INSTALLATION.
3. HIGH TEMPERATURE INSULATION. REFER TO GENERATOR MANUFACTURER'S DATA FOR EXHAUST TEMPERATURE INFORMATION AND TO NFPA 37 CHAPTER 7 FOR INSULATION REQUIREMENTS.
4. HEAT DISSIPATION CHAMBER.
5. EXHAUST PIPE. MINIMUM DIAMETER PER GENSET MANUFACTURER'S REQUIREMENTS. INSTALL SPACERS AS REQUIRED TO CENTER EXHAUST PIPE WITHIN THIMBLE.
6. HEAT DISSIPATION VENT OPENINGS (INTERIOR SIDE OF THIMBLE ONLY.)

STANDBY GENERATOR EXHAUST PIPE SURFACE PENETRATION (EXHAUST THIMBLE)

16622

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CITY OF SOUTH MILWAUKEE
NORTH CHICAGO LIFT STATION IMPROVEMENTS
SOUTH MILWAUKEE, WISCONSIN

STANDARD DETAILS
ELECTRICAL DETAILS

VERIFY SCALES
LENGTH OF BAR IS 1" ON ORIGINAL DRAWING
1:1
PLOT SCALE, ADJUST SCALE(S) ACCORDINGLY

DESIGNED BY: N.A.O.
DRAWN BY: J.T.H.
CHECKED BY: F.X.T.
APPROVED BY: W.A.E.

PROJECT NO. 5795

DATE APRIL 2018

DRAWING NO. 99-E-1

PSLTSCALE: 1 LTSCALE: 1
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