

\$987,654.32  
ORIGINAL

BID OF SPEEDWAY SAND & GRAVEL, INC.

2021

PROPOSAL, CONTRACT, BOND AND SPECIFICATIONS

FOR

THURBER LIFT STATION REPLACEMENT

CONTRACT NO. 9063

PROJECT NO. 11672

MUNIS NO. 11672

IN

MADISON, DANE COUNTY, WISCONSIN

AWARDED BY THE COMMON COUNCIL  
MADISON, WISCONSIN ON OCTOBER 19, 2021

CITY ENGINEERING DIVISION  
1600 EMIL STREET  
MADISON, WISCONSIN 53713

<https://bidexpress.com/login>

**THURBER LIFT STATION REPLACEMENT  
CONTRACT NO. 9063**

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This Proposal, and Agreement have  
been prepared by:

**CITY ENGINEERING DIVISION  
CITY OF MADISON  
MADISON, DANE COUNTY, WISCONSIN**

*EN- Greg Fries* for RFP  
\_\_\_\_\_  
Robert F. Phillips, P.E., City Engineer

RFP: kdf

## SECTION A: ADVERTISEMENT FOR BIDS AND INSTRUCTIONS TO BIDDERS

### REQUEST FOR BID FOR PUBLIC WORKS CONSTRUCTION CITY OF MADISON, WISCONSIN

#### A BEST VALUE CONTRACTING MUNICIPALITY

PROJECT NAME:	THURBER LIFT STATION REPLACEMENT
CONTRACT NO.:	9063
SBE GOAL	3%
BID BOND	5%
SBE PRE BID MEETING	See Pre Bid Meeting info below
PREQUALIFICATION APPLICATION DUE (2:00 P.M.)	9/2/2021
BID SUBMISSION (2:00 P.M.)	9/9/2021
BID OPEN (2:30 P.M.)	9/9/2021
PUBLISHED IN WSJ	8/19/2021 & 8/26/2021

SBE PRE BID MEETING: Small Business Enterprise Pre-Bid Meetings are not being held in person at this time. Contractors can schedule one-on-one phone calls with Juan Pablo Torres Meza in Affirmative Action to count towards good faith efforts. Juan Pablo can be reached at (608) 261-9162 or by email, [jtorresmeza@cityofmdison.com](mailto:jtorresmeza@cityofmdison.com).

PREQUALIFICATION APPLICATION: Forms are available on our website, [www.cityofmadison.com/engineering/developers-contractors/contractors/how-to-get-prequalified](http://www.cityofmadison.com/engineering/developers-contractors/contractors/how-to-get-prequalified). If not currently prequalified in the categories listed in Section A, an amendment to your Prequalification will need to be submitted prior to the same due date. Postmark is not applicable.

BIDS TO BE SUBMITTED: by hand to 1600 EMIL ST., MADISON, WI 53713 or online at [www.bidexpress.com](http://www.bidexpress.com).

THE BID OPENING is at 1600 EMIL ST., MADISON, WI 53713.

Bids may be submitted on line through Bid Express or in person at 1600 Emil St. The bids will be posted on line after the bid opening. If you have any questions, please call Alane Boutelle at (608) 267-1197, or John Fahrney at (608) 266-9091.

#### STANDARD SPECIFICATIONS

The City of Madison's Standard Specifications for Public Works Construction - 2021 Edition, as supplemented and amended from time to time, forms a part of these contract documents as if attached hereto.

These standard specifications are available on the City of Madison Public Works website, [www.cityofmadison.com/engineering/developers-contractors/standard-specifications](http://www.cityofmadison.com/engineering/developers-contractors/standard-specifications).

The Contractor shall review these Specifications prior to preparation of proposals for the work to be done under this contract, with specific attention to Article 102, "BIDDING REQUIREMENTS AND CONDITIONS" and Article 103, "AWARD AND EXECUTION OF THE CONTRACT." For the convenience of the bidder, below are highlights of three subsections of the specifications.

#### SECTION 102.1: PRE-QUALIFICATION OF BIDDERS

In accordance with Wisconsin State Statutes 66.0901 (2) and (3), all bidders must submit to the Board of Public Works proof of responsibility on forms furnished by the City. The City requires that all bidders be qualified on a biennial basis.

Bidders must present satisfactory evidence that they have been regularly engaged in the type of work specified herein and they are fully prepared with necessary capital, materials, machinery and supervisory personnel to conduct the work to be contracted for to the satisfaction of the City. All bidders must be pre-qualified by the Board of Public Works for the type of construction on which they are bidding prior to the opening of the bid.

In accordance with Section 39.02(9)(a)l. of the General Ordinances, all bidders shall submit in writing to the Affirmative Action Division Manager of the City of Madison, a Certificate of Compliance or an Affirmative Action Plan at the same time or prior to the submission of the proof of responsibility forms.

The bidder shall be disqualified if the bidder fails to or refuses to, prior to opening of the bid, submit a Certificate of compliance, Affirmative Action Plan or Affirmative Action Data Update, as applicable, as defined by Section 39.02 of the General Ordinances (entitled Affirmative Action) and as required by Section 102.11 of the Standard Specifications.

#### SECTION 102.4 PROPOSAL

No bid will be accepted that does not contain an adequate or reasonable price for each and every item named in the Schedule of Unit Prices.

A lump sum bid for the work in accordance with the plans and specifications is required. The lump sum bid must be the same as the total amounts bid for the various items and it shall be inserted in the space provided.

All papers bound with or attached to the proposal form are considered a part thereof and must not be detached or altered when the proposal is submitted. The plans, specifications and other documents designated in the proposal form will be considered a part of the proposal whether attached or not.

A proposal submitted by an individual shall be signed by the bidder or by a duly authorized agent. A proposal submitted by a partnership shall be signed by a member/partner or by a duly authorized agent thereof. A proposal submitted by a corporation shall be signed by an authorized officer or duly authorized registered agent of such corporation, and the proposal shall show the name of the State under the laws of which such corporation was chartered. The required signatures shall in all cases appear in the space provided thereof on the proposal.

Each proposal shall be placed, together with the proposal guaranty, in a sealed envelope, so marked as to indicate name of project, the contract number or option to which it applies, and the name and address of the Contractor or submitted electronically through Bid Express ([www.bidexpress.com](http://www.bidexpress.com)). Proposals will be accepted at the location, the time and the date designated in the advertisement. Proposals received after the time and date designated will be returned to the bidder unopened.

#### SECTION 102.5: BID DEPOSIT (PROPOSAL GUARANTY)

All bids, sealed or electronic, must be accompanied with a Bid Bond (City of Madison form) equal to at least 5% of the bid or a Certificate of Annual/Biennial Bid Bond or certified check, payable to the City Treasurer. Bid deposit of the successful bidders shall be returned within forty-eight (48) hours following execution of the contract and bond as required.

#### MINOR DISCREPENCIES

Bidder is responsible for submitting all forms necessary for the City to determine compliance with State and City bidding requirements. Notwithstanding any language to the contrary contained herein, the City may exercise its discretion to allow bidders to correct or supplement submissions after bid opening, if the minor discrepancy, bid irregularity or omission is insignificant and not one related to price, quality, quantity, time of completion or performance of the contract.



**Bidders for this Contract(s) must be Pre-Qualified for at least one of the following type(s) of construction denoted by an**

Building Demolition

- |   |  |
|---|--|
| 101 <input type="checkbox"/> Asbestos Removal | 110 <input type="checkbox"/> Building Demolition |
| 120 <input type="checkbox"/> House Mover      |  |

Street, Utility and Site Construction

- |   |  |
|---|--|
| 201 <input type="checkbox"/> Asphalt Paving   | 265 <input type="checkbox"/> Retaining Walls, Precast Modular Units  |
| 205 <input type="checkbox"/> Blasting   | 270 <input type="checkbox"/> Retaining Walls, Reinforced Concrete  |
| 210 <input type="checkbox"/> Boring/Pipe Jacking  | 275 <input checked="" type="checkbox"/> Sanitary, Storm Sewer and Water Main Construction                  |
| 215 <input type="checkbox"/> Concrete Paving  | 276 <input type="checkbox"/> Sawcutting  |
| 220 <input type="checkbox"/> Con. Sidewalk/Curb & Gutter/Misc. Flat Work                    | 280 <input type="checkbox"/> Sewer Lateral Drain Cleaning/Internal TV Insp.                                |
| 221 <input type="checkbox"/> Concrete Bases and Other Concrete Work                         | 285 <input type="checkbox"/> Sewer Lining  |
| 222 <input type="checkbox"/> Concrete Removal   | 290 <input type="checkbox"/> Sewer Pipe Bursting   |
| 225 <input type="checkbox"/> Dredging   | 295 <input type="checkbox"/> Soil Borings  |
| 230 <input type="checkbox"/> Fencing  | 300 <input type="checkbox"/> Soil Nailing  |
| 235 <input type="checkbox"/> Fiber Optic Cable/Conduit Installation                         | 305 <input type="checkbox"/> Storm & Sanitary Sewer Laterals & Water Svc.                                  |
| 240 <input type="checkbox"/> Grading and Earthwork  | 310 <input type="checkbox"/> Street Construction   |
| 241 <input type="checkbox"/> Horizontal Saw Cutting of Sidewalk                             | 315 <input type="checkbox"/> Street Lighting   |
| 242 <input type="checkbox"/> Hydro Excavating   | 318 <input type="checkbox"/> Tennis Court Resurfacing  |
| 243 <input type="checkbox"/> Infrared Seamless Patching                                     | 320 <input type="checkbox"/> Traffic Signals   |
| 245 <input type="checkbox"/> Landscaping, Maintenance                                       | 325 <input type="checkbox"/> Traffic Signing & Marking   |
| 246 <input type="checkbox"/> Ecological Restoration   | 332 <input type="checkbox"/> Tree pruning/removal  |
| 250 <input type="checkbox"/> Landscaping, Site and Street                                   | 333 <input type="checkbox"/> Tree, pesticide treatment of  |
| 251 <input type="checkbox"/> Parking Ramp Maintenance                                       | 335 <input type="checkbox"/> Trucking  |
| 252 <input type="checkbox"/> Pavement Marking   | 340 <input type="checkbox"/> Utility Transmission Lines including Natural Gas, Electrical & Communications |
| 255 <input type="checkbox"/> Pavement Sealcoating and Crack Sealing                         | 399 <input type="checkbox"/> Other _____   |
| 260 <input type="checkbox"/> Petroleum Above/Below Ground Storage Tank Removal/Installation |  |
| 262 <input type="checkbox"/> Playground Installer   |  |

Bridge Construction

- 501  Bridge Construction and/or Repair

Building Construction

- |  |   |
|--|---|
| 401 <input type="checkbox"/> Floor Covering (including carpet, ceramic tile installation, rubber, VCT) | 437 <input type="checkbox"/> Metals   |
| 402 <input type="checkbox"/> Building Automation Systems   | 440 <input type="checkbox"/> Painting and Wallcovering                                |
| 403 <input type="checkbox"/> Concrete  | 445 <input type="checkbox"/> Plumbing   |
| 404 <input type="checkbox"/> Doors and Windows   | 450 <input type="checkbox"/> Pump Repair  |
| 405 <input type="checkbox"/> Electrical - Power, Lighting & Communications                             | 455 <input type="checkbox"/> Pump Systems   |
| 410 <input type="checkbox"/> Elevator - Lifts  | 460 <input type="checkbox"/> Roofing and Moisture Protection                          |
| 412 <input type="checkbox"/> Fire Suppression  | 464 <input type="checkbox"/> Tower Crane Operator                                     |
| 413 <input type="checkbox"/> Furnishings - Furniture and Window Treatments                             | 461 <input type="checkbox"/> Solar Photovoltaic/Hot Water Systems                     |
| 415 <input type="checkbox"/> General Building Construction, Equal or Less than \$250,000               | 465 <input type="checkbox"/> Soil/Groundwater Remediation                             |
| 420 <input checked="" type="checkbox"/> General Building Construction, \$250,000 to \$1,500,000        | 466 <input type="checkbox"/> Warning Sirens   |
| 425 <input type="checkbox"/> General Building Construction, Over \$1,500,000                           | 470 <input type="checkbox"/> Water Supply Elevated Tanks                              |
| 428 <input type="checkbox"/> Glass and/or Glazing  | 475 <input type="checkbox"/> Water Supply Wells                                       |
| 429 <input type="checkbox"/> Hazardous Material Removal  | 480 <input type="checkbox"/> Wood, Plastics & Composites - Structural & Architectural |
| 430 <input type="checkbox"/> Heating, Ventilating and Air Conditioning (HVAC)                          | 499 <input type="checkbox"/> Other _____  |
| 433 <input type="checkbox"/> Insulation - Thermal  |   |
| 435 <input type="checkbox"/> Masonry/Tuck pointing   |   |

State of Wisconsin Certifications

- 1  Class 5 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for quarries, open pits and road cuts.
- 2  Class 6 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for trenches, site excavations, basements, underwater demolition, underground excavations, or structures 15 feet or less in height.
- 3  Class 7 Blaster - Blasting Operations and Activities for structures greater than 15' in height, bridges, towers, and any of the objects or purposes listed as "Class 5 Blaster or Class 6 Blaster".
- 4  Petroleum Above/Below Ground Storage Tank Removal and Installation (Attach copies of State Certifications.)
- 5  Hazardous Material Removal (Contractor to be certified for asbestos and lead abatement per the Wisconsin Department of Health Services, Asbestos and Lead Section (A&LS).) See the following link for application: [www.dhs.wisconsin.gov/Asbestos/Cert](http://www.dhs.wisconsin.gov/Asbestos/Cert). State of Wisconsin Performance of Asbestos Abatement Certificate must be attached.
- 6  Certification number as a Certified Arborist or Certified Tree Worker as administered by the International Society of Arboriculture
- 7  Pesticide application (Certification for Commercial Applicator For Hire with the certification in the category of turf and landscape (3.0) and possess a current license issued by the DATCP)
- 8  State of Wisconsin Master Plumbers License.

## SECTION B: PROPOSAL

Please refer to the  
Bid Express Website  
at <https://bidexpress.com>  
look up contract number  
and go to  
Section B: Proposal Page

You can access all City of Madison bid solicitations for FREE at [www.bidexpress.com](http://www.bidexpress.com)

Click on the "Register for Free" button and follow the instructions to register your company and yourself. You will be asked for a payment subscription preference, since you may wish to bid online someday. Simply choose the method to pay on a 'per bid' basis. This requires no payment until / unless you actually bid online. You can also choose the monthly subscription plan at this time. You will, however, be asked to provide payment information. Remember, you can change your preference at anytime. You will then be able to complete your free registration and have full access to the site. Your free access does not require completion of the 'Digital ID' process, so you will have instant access for viewing and downloading. To be prepared in case you ever do wish to bid online, you may wish to establish your digital ID also, since you cannot bid without a Digital ID.

If you have any problems with the free registration process, you can call the bidexpress help team, toll free at 1-888-352-2439 (option 1, option1).

## SECTION C: SMALL BUSINESS ENTERPRISE

### Instructions to Bidders City of Madison SBE Program Information

#### 2 Small Business Enterprise (SBE) Program Information

##### 2.1 Policy and Goal

The City of Madison reaffirms its policy of nondiscrimination in the conduct of City business by maintaining a procurement process which remains open to all who have the potential and ability to sell goods and services to the City. It is the policy of the City of Madison to allow Small Business Enterprises (SBE) maximum feasible opportunity to participate in City of Madison contracting. The bidder acknowledges that its bid has been submitted in accordance with the SBE program and is for the public's protection and welfare.

Please refer to the "ADVERTISEMENT FOR BIDS" for the goal for the utilization of SBEs on this project. SBEs may participate as subcontractors, vendors and/or suppliers, which provide a commercially useful function. The dollar value for SBE suppliers or 'materials only' vendors shall be discounted to 60% for purposes of meeting SBE goals.

A bidder which achieves or exceeds the SBE goal will be in compliance with the SBE requirements of this project. In the event that the bidder is unable to achieve the SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Failure to either achieve the goal or demonstrate a good faith effort to do so will be grounds for the bidder being deemed a non-responsible contractor ineligible for award of this contract.

A bidder may count towards its attainment of the SBE goal only those expenditures to SBEs that perform a commercially useful function. For purposes of evaluating a bidder's responsiveness to the attainment of the SBE goal, the contract participation by an SBE is based on the percentage of the total base bid proposed by the Contractor. The total base bid price is inclusive of all addenda.

Work performed by an SBE firm in a particular transaction can be counted toward the goal only if it involves a commercially useful function. That is, in light of industry practices and other relevant considerations, does the SBE firm have a necessary and useful role in the transaction, of a kind for which there is a market outside the context of the SBE Program, or is the firm's role a superfluous step added in an attempt to obtain credit towards goals? If, in the judgment of the Affirmative Action Division, the SBE firm will not perform a commercially useful function in the transaction, no credit towards goals will be awarded.

The question of whether a firm is performing a commercially useful function is completely separate from the question of whether the firm is an eligible SBE. A firm is eligible if it meets the definitional criteria and ownership and control requirements, as set forth in the City of Madison's SBE Program.

If the City of Madison determines that the SBE firm is performing a commercially useful function, then the City of Madison must then decide what that function is. If the commercially useful function is that of an SBE vendor / supplier that regularly transacts business with the respective product, then the City of Madison will count 60% of the value of the product supplied toward SBE goals.

To be counted, the SBE vendor / supplier must be engaged in selling the product in question to the public. This is important in distinguishing an SBE vendor / supplier, which has a regular trade with a variety of customers, from a firm which performs supplier-like functions on an ad hoc basis or for only one or two contractors with whom it has a special relationship.

A supplier of bulk goods may qualify as an eligible SBE vendor / supplier if it either maintains an inventory or owns or operates distribution equipment. With respect to the distribution equipment; e.g., a fleet of trucks, the term "operates" is intended to cover a situation in which the supplier leases the equipment on a regular basis for its entire business. It is not intended to cover a situation in which the firm simply provides drivers for trucks owned or leased by another party; e.g., a prime contractor, or leases such a party's trucks on an ad hoc basis for a specific job.

If the commercially useful function being performed is not that of a qualified SBE vendor / supplier, but rather that of delivery of products, obtaining bonding or insurance, procurement of personnel, acting as a broker or manufacturer's representative in the procurement of supplies, facilities, or materials, etc., only the fees or commissions will apply towards the goal.

For example, a business that simply transfers title of a product from manufacturer to ultimate purchaser; e. g., a sales representative who re-invoices a steel product from the steel company to the Contractor, or a firm that puts a product into a container for delivery would not be considered a qualified SBE vendor / supplier. The Contractor would not receive credit based on a percentage of the cost of the product for working with such firms.

Concerning the use of services that help the Contractor obtain needed supplies, personnel, materials or equipment to perform a contract: only the fee received by the service provider will be counted toward the goal. For example, use of a SBE sales representative or distributor for a steel company, if performing a commercially useful function at all, would entitle the Contractor receiving the steel to count only the fee paid to the representative or distributor toward the goal. This provision would also govern fees for professional and other services obtained expressly and solely to perform work relating to a specific contract.

Concerning transportation or delivery services: if an SBE trucking company picks up a product from a manufacturer or a qualified vendor / supplier and delivers the product to the Contractor, the commercially useful function it is performing is not that of a supplier, but simply that of a transporter of goods. Unless the trucking company is itself the manufacturer or a qualified vendor / supplier in the product, credit cannot be given based on a percentage of the cost of the product. Rather, credit would be allowed for the cost of the transportation service.

The City is aware that the rule's language does not explicitly mention every kind of business that may contribute work on this project. In administering these programs, the City would, on a case-by-case basis, determine the appropriate counting formula to apply in a particular situation.

## **2.2 Contract Compliance**

Questions concerning the SBE Program shall be directed to the Contract Compliance Officer of the City of Madison Department of Civil Rights, Affirmative Action Division, 210 Martin Luther King, Jr. Blvd., Room 523, Madison, WI 53703; telephone (608) 266-4910.

## 2.3 Certification of SBE by City of Madison

The Affirmative Action Division maintains a directory of SBEs which are currently certified as such by the City of Madison. Contact the Contract Compliance Officer as indicated in Section 2.2 to receive a copy of the SBE Directory or you may access the SBE Directory online at [www.cityofmadison.com/civil-rights/contract-compliance/targeted-business-enterprise-programs/targeted-business-enterprise](http://www.cityofmadison.com/civil-rights/contract-compliance/targeted-business-enterprise-programs/targeted-business-enterprise).

All contractors, subcontractors, vendors and suppliers seeking SBE status must complete and submit the **Targeted Business Certification Application** to the City of Madison Affirmative Action Division by the time and date established for receipt of bids. A copy of the Targeted Business Certification Application is available by contacting the Contract Compliance Officer at the address and telephone indicated in Section 2.2 or you may access the Targeted Business Certification Application online at [www.cityofmadison.com/civil-rights/contract-compliance/targeted-business-enterprise-programs/targeted-business-enterprise](http://www.cityofmadison.com/civil-rights/contract-compliance/targeted-business-enterprise-programs/targeted-business-enterprise). Submittal of the Targeted Business Certification Application by the time specified does not guarantee that the applicant will be certified as a SBE eligible to be utilized towards meeting the SBE goal for this project.

## 2.4 Small Business Enterprise Compliance Report

### 2.4.1 Good Faith Efforts

Bidders shall take all necessary affirmative steps to assure that SBEs are utilized when possible and that the established SBE goal for this project is achieved. A contractor who self performs a portion of the work, and is pre-qualified to perform that category of work, may subcontract that portion of the work, but shall not be required to do so. When a bidder is unable to achieve the established SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Such a good faith effort should include the following:

- 2.4.1.1 Attendance at the pre-bid meeting.
- 2.4.1.2 Using the City of Madison's directory of certified SBEs to identify SBEs from which to solicit bids.
- 2.4.1.3 Assuring that SBEs are solicited whenever they are potential sources.
- 2.4.1.4 Referring prospective SBEs to the City of Madison Affirmative Action Division for certification.
- 2.4.1.5 Dividing total project requirements into smaller tasks and/or quantities, where economically feasible, to permit maximum feasible SBE participation.
- 2.4.1.6 Establishing delivery schedules, where requirements permit, which will encourage participation by SBEs.
- 2.4.1.7 Providing SBEs with specific information regarding the work to be performed.
- 2.4.1.8 Contacting SBEs in advance of the deadline to allow such businesses sufficient time to prepare a bid.
- 2.4.1.9 Utilizing the bid of a qualified and competent SBE when the bid of such a business is deemed reasonable (i.e. 5% above the lowest bidder), although not necessarily low.
- 2.4.1.10 Contacting SBEs which submit a bid, to inquire about the details of the bid and confirm that the scope of the work was interpreted as intended.
- 2.4.1.11 Completion of Cover Page (page C-6), Summary Sheet (page C-7) and SBE Contact Reports (pages C-8 and C9) if applicable.

## 2.4.2 Reporting SBE Utilization and Good Faith Efforts

The Small Business Enterprise Compliance Report is to be submitted by the bidder with the bid. This report is due by the specified bid closing time and date. Bids submitted without a completed SBE Compliance Report as outlined below may be deemed non-responsible and the bidder ineligible for award of this contract. Notwithstanding any language to the contrary contained herein, the City may exercise its discretion to allow bidders to correct or supplement submissions after bid opening, if the minor discrepancy, bid irregularity or omission is insignificant and not one related to price, quality, quantity, time of completion, performance of the contract, or percentage of SBE utilization.

2.4.2.1 If the Bidder meets or exceeds the goal established for SBE utilization, the Small Business Enterprise Compliance Report shall consist of the following:

2.4.2.1.1 **Cover Page**, Page C-6; and

2.4.2.1.2 **Summary Sheet**, C-7.

2.4.2.2 If the bidder does not meet the goal established for SBE utilization, the Small Business Enterprise Compliance Report shall consist of the following:

2.4.2.2.1 **Cover Page**, Page C-6;

2.4.2.2.2 **Summary Sheet**, C-7; and

2.4.2.2.3 **SBE Contact Report**, C-8 and C-9. (A separate Contact Report must be completed for each applicable SBE which is not utilized.)

## 2.5 Appeal Procedure

A bidder which does not achieve the established goal and is found non-responsible for failure to demonstrate a good faith effort to achieve such goal and subsequently denied eligibility for award of contract may appeal that decision to the Small Business Enterprises Appeals Committee. All appeals shall be made in writing, and shall be delivered to and received by the City Engineer no later than 4:30 PM on the third business day following the bidder's receipt of the written notification of ineligibility by the Affirmative Action Division Manager. Postmark not acceptable. The notice of appeal shall state the basis for the appeal of the decision of the Affirmative Action Division Manager. The Appeal shall take place in accordance with Madison General Ordinance 33.54.

## 2.6 SBE Requirements After Award of the Contract

The successful bidder shall identify SBE subcontractors, suppliers and vendors on the subcontractor list in accordance with the specifications. The Contractor shall submit a detailed explanation of any variances between the listing of SBE subcontractors, vendors and/or suppliers on the subcontractor list and the Contractor's SBE Compliance Report for SBE participation.

No change in SBE subcontractors, vendors and/or suppliers from those SBEs indicated in the SBE Compliance Report will be allowed without prior approval from the Engineer and the Affirmative Action Division. The contractor shall submit in writing to the City of Madison Affirmative Action Division a request to change any SBE citing specific reasons which necessitate such a change. The Affirmative Action Division will use a general test of reasonableness in approving or rejecting the contractor's request for change. If the request is approved, the Contractor will make every effort to utilize another SBE if available.

The City will monitor the project to ensure that the actual percentage commitment to SBE firms is carried out.

## **2.7 SBE Definition and Eligibility Guidelines**

A Small Business Enterprise is a business concern awarded certification by the City of Madison. For the purposes of this program a Small Business Enterprise is defined as:

- A. An independent business operated under a single management. The business may not be a subsidiary of any other business and the stock or ownership may not be held by any individual or any business operating in the same or a similar field. In determining whether an entity qualifies as a SBE, the City shall consider all factors relevant to being an independent business including, but not limited to, the date the business was established, adequacy of its resources for the work in which it proposes to involve itself, the degree to which financial, equipment leasing and other relationships exist with other ineligible firms in the same or similar lines of work. SBE owner(s) shall enjoy the customary incidents of ownership and shall share in the risks and profits commensurate with their enjoyment interests, as demonstrated by an examination of the substance rather than form or arrangements that may be reflected in its ownership documents.
- B. A business that has averaged no more than \$4.0 million in annual gross receipts over the prior three year period and the principal owner(s) do not have a personal net worth in excess of \$1.32 million.

Firm and/or individuals that submit fraudulent documents/testimony may be barred from doing business with the City and/or forfeit existing contracts.

SBE certification is valid for one (1) year unless revoked.

**SECTION D: SPECIAL PROVISIONS**  
**THURBER LIFT STATION REPLACEMENT**  
**CONTRACT NO. 9063**

It is the intent of these Special Provisions to set forth the final contractual intent as to the matter involved and shall prevail over the Standard Specifications and plans whenever in conflict therewith. In order that comparisons between the Special Provisions can be readily made, the numbering system for the Special Provisions is equivalent to that of the Specifications.

Whenever in these Specifications the term "Standard Specifications" appears, it shall be taken to refer to the City of Madison Standard Specifications for Public Works Construction and Supplements thereto.

**ARTICLE 101**                    **DEFINITIONS AND TERMS**

**Relationship Between the City and Strand Associates, Inc.®** Strand Associates, Inc.® has been hired by the City to prepare drawings and specifications for this project. Additionally, Strand will assist the City by providing shop drawing review and responding to questions that may arise during construction. The City will provide resident engineering services and contract administration and is referred to as the City and/or Engineer in the Contract Documents.

Strand Associates, Inc.® will not supervise, direct, control or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or safety precautions and programs incidental thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the furnishing or performance of the Work. Strand Associates, Inc.® will not be responsible for Contractor's failure to perform or furnish the Work in accordance with the Contract Documents. Strand Associates, Inc.® will not be responsible for the acts or omissions of Contractor or of any subcontractor, any supplier, or of any person or organization performing or furnishing any of the Work.

During construction, the duties and responsibilities of Strand Associates, Inc.® include the following:

1. Review Contractor product submittals.
2. Report to City when clarifications and interpretations of the Contract Documents are needed. Consider, evaluate, and report to City in regard to Contractor's requests for modification.
3. Provide site visits to observe the Work.

Strand Associates, Inc.® shall not:

1. Authorize any deviation from the Contract Documents or substitutions of materials or equipment.
2. Exceed limitations of City's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractor, Suppliers or Contractor's Superintendent
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of construction
5. Advise on, issue directions regarding, or assume control over safety precautions and programs in connection with the Work.
6. Accept shop drawing or sample submittals from anyone other than the Contractor.
7. Authorize the City to occupy the Project in whole or in part.
8. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by City.



**SPECIAL PROVISIONS.** Add the following to the end of the definitions of **SPECIAL PROVISIONS:**

**TECHNICAL SPECIFICATIONS** prepared by Strand Associates Inc.®

**SECTION 102.11:      BEST VALUE CONTRACTING**

This Contract shall be considered a Best Value Contract if the Contractor's bid is equal to or greater than \$65,000 for a single trade contract; or equal to or greater than \$318,000 for a multi-trade contract pursuant to MGO 33.07(7).

**ARTICLE 104            SCOPE OF WORK**

The work under this contract shall include, but is not limited to, demolition of existing lift station building, removal/replacement of existing pumps, removal/replacement of plumbing, removal/replacement of electrical systems, removal/replacement of electrical controls, installation of emergency generator, installation telemetry antenna tower, and restoration of project site.

The Contractor shall view the site prior to bidding to become familiar with the existing conditions. It will be the responsibility of the Contractor to work with the utilities located in the right of way to resolve conflicts during the construction process.

**SECTION 104.4         INCREASE OR DECREASE QUANTITIES**

The Contractor shall note that some bid item quantities may increase or decrease based on what is encountered in the field. If the actual field conditions vary from the plan quantity, no additional compensation shall be given for increasing or decreasing quantities. Any overruns shall be paid for under the appropriate bid item(s) without any penalty or change to the bid price for the associated bid item. The Contractor shall not be reimbursed for any deletions to the contract. No change to the unit bid price will be allowed for changes to the quantities.

**SECTION 105.9         SURVEYS, POINTS AND INSTRUCTIONS**

The City shall make all surveys unless otherwise specified in the contract.

The Contractor shall provide the Engineer a 48-hour notice prior to the time the Contractor needs stakes. The Engineer will furnish and set the construction survey stakes or reference points and bench marks necessary to establish the location, alignment and elevation for the project and such stakes will bear instructive markings or be accompanied by necessary detailed instructions. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall govern and execute the work. The Contractor shall furnish, such other facilities and labor as may be required in establishing such other points and lines necessary to the prosecution of the work. The Contractor shall furnish additional stakes and other material necessary for maintaining the points and lines given. The Contractor shall be responsible for the preservation of all stakes and marks, and if any of the survey stakes or marks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost to the City of replacing them may be charged against the Contractor on a time and materials basis and be deducted from the payment of the work.

Per the Dane County Zoning Permit, a location survey is required to verify compliance with zoning ordinance setbacks. **The location survey shall be performed by a City registered land surveyor when the foundation/basement walls are completed and before any other work is done on the project.**

**SECTION 105.12        COOPERATION BY THE CONTRACTOR**

The Contractor shall use care around existing trees, plantings, fences, walls, steps and driveways that are indicated on the plans to remain. Damage to these items during construction shall be repaired or replaced at the Contractor's expense. No trees, other than those shown on the plan to be removed, shall

be cut without the approval of the City Construction Engineer and the City Forester; the abutting property owners shall be notified in accordance with the City's Administrative Procedure Memorandum No. 6-2.

The Contractor shall maintain access to all properties along or near the project area at all times. This includes local residents, mail delivery, garbage/recycling pickup and emergency vehicles. Notice shall be given to the residents on Thurber Avenue 48 hours before any work is done that would obstruct their driveways. Contractor shall maintain parking in parking lot for the adjacent Thurber Park.

Construction disturbance shall remain within the limits of disturbance shown on the site plan on the sheet 5, D1.1. Materials and Vehicles shall not be stored within the limits of Thurber Ave or Fair Oaks Ave.

#### **Coordination with Utilities**

Work in this contract may require utility relocations to complete the work shown on the plan sheets. It will be the responsibility of the Contractor to work with the utilities located in the project area to resolve conflicts during the construction process and provide working area for installation of new facilities.

ATC (overhead), Madison Gas (underground) and Electric (overhead) have underground and/or overhead facilities within or near the project limits.

New gas and electrical service is required as part of the project. The Contractor shall be responsible for coordinating and providing working area for the installation of the new 100A 120/208V, 3-phase, 4-wire, electrical service. The contractor shall be responsible for coordinating and providing working area for MGE gas to install new natural gas service and meter. The Contractor shall be responsible for applying for and payment of any permits and/or fees required for the installation of the gas and electrical services.

#### **SECTION 107.6            DUST PROOFING**

The Contractor shall take all necessary steps to control dust arising from operations connected with this contract. When ordered by the City Construction Engineer, the Contractor shall dust proof the construction area by using power sweepers and water. Dust proofing shall be incidental with operations connected with this contract.

#### **SECTION 107.7            MAINTENANCE OF TRAFFIC**

All signing and barricading shall conform to Part VI of the Federal Highways Administrations "Manual on Uniform Traffic Control Devices" (MUTCD), the State of Wisconsin Standard Facilities Development Manual (including Chapter 16 – Standard Detail Drawings) and the City of Madison Standards for sidewalk and bikeway closures.

The Contractor shall submit an acceptable Traffic Control Plan, including all necessary phases, to Tom Mohr, tmohr@cityofmadison.com. A minimum of five (5) working days prior to the pre-construction meeting, The Traffic Control Plan shall address all requirements of this section of the Special Provisions. The Contractor shall not start work on this project until the Traffic Engineering Division has approved a traffic control plan and traffic control devices have been installed in accordance with the approved plan. Failure of the Contractor to obtain approval of a Traffic Control Plan, as specified above, may prevent the Contractor from starting work and shall be considered a delay of the project caused by the Contractor.

The traffic control plan may need to be altered as conditions change in the field or as unexpected conditions occur. This shall include relocating existing traffic control or providing additional traffic control. The Contractor shall install and maintain any necessary modifications or additions to the traffic control, as directed by the City Traffic Engineer, at no cost to the City.

Traffic Control shall be measured as a lump sum. Payment for the Traffic control is full compensation for constructing, assembling, hauling, erecting, re-erecting, maintaining, restoring, and removing non-permanent traffic signs, drums, barricades, and similar control devices, for providing, placing, and maintaining the work zone. Maintaining shall include replacing damaged or stolen traffic control devices.

### **Thurber Avenue**

Thurber Avenue shall remain open to two way traffic for the duration of the project. The Contractor shall be required to flag traffic if necessary to maintain two way traffic on Thurber Avenue.

### **Fair Oaks Avenue**

Fair Oaks Avenue shall remain open to two way traffic for the duration of the project. During weekday afternoon peak hours (3:30 p.m. to 6:00 p.m.) one travel lane in each direction shall be maintained. During all other times, flaggers may be used to maintain both directions of traffic.

Construction equipment and materials are not to be stored within the street right-of-way that is open to traffic during non-working hours. Construction equipment and materials are not to be stored within the street right-of-way that is outside the project limits.

The Contractor shall not in any manner unnecessarily obstruct the streets or crossings, and shall at all times and under all circumstances provide safe and sufficient means for foot passengers and vehicles. When sidewalk closures are necessary for completion of the work, sidewalk closed signs shall be provided at the cross walks prior to the closure.

Sidewalk closures shall be signed at the crosswalks prior to the closure. Sidewalks shall be fully open during non-working hours except where necessary to enable sidewalk to cure. In areas of sidewalk construction, provide a temporary surface for pedestrian access at all times. The temporary surface shall meet Americans with Disabilities Act Accessibility Guidelines (ADAAG) requirements and shall consist of temporary asphaltic surface, any grade of concrete, skid resistant steel plating, or alternative material as approved by the Construction Engineer. Gravel or base course material is not acceptable. Maintaining Sidewalk is considered incidental to the contract.

Contact Tom Mohr, Traffic Engineering Division, [tmohr@cityofmadison.com](mailto:tmohr@cityofmadison.com), with any questions concerning these traffic control specifications.

### **SECTION 107.12 RAILROAD - HIGHWAY GRADE SEPARATIONS AND APPROACHES, NEW RAILROAD CROSSINGS, AND OPERATION ON RAILROAD RIGHT- OF WAY**

The company representative who may be consulted by Bidders and Contractors with regard to railroad requirements is Roger Schaalma of the Wisconsin & Southern Railroad (WSOR), at (608) 243-9129 x 4211. Notice must be given to Roger Schaalma at least 72 hours prior to working within twenty-five feet (25') of the Railroad Tracks. The Contractor shall obtain the authorization of the WSOR to work within twenty-five feet (25') of the railroad tracks prior to any work being done. Any time that work is being done within twenty-five feet (25') of the track, a WSOR flag person must be present.

It shall be the responsibility of the Contractor to compensate the Railroad for the flag person requirements. Prior to any work within twenty-five feet (25') of the Railroad Tracks, the Contractor shall provide to WSOR an estimate of the time required to perform the necessary work within twenty-five feet (25') of the Railroad Tracks and the Contractor shall pre-pay WSOR an estimated cost for compensation for a flag person based on the estimated time required to perform all work within twenty-five feet (25') of the tracks and the current hourly rate of compensation charged by WSOR for a flag person. In the event that the pre-paid amount for flag person compensation exceeds the actual cost required for the compensation of the flag person, any excess pre-paid amount will be refunded to the Contractor. In the event that actual cost for compensation of the flag person exceeds the pre-paid estimate, the Contractor shall submit an additional pre-payment for the estimated additional cost for compensation of a flag person, prior to any work continuing within twenty-five feet (25') of the tracks.

Absolutely no staging of equipment or materials will be allowed within the railroad right-of-way.

If a Contractor violates any of these requirements, the Wisconsin & Southern Railroad reserves the right to remove and prohibit the Contractor from any further access or encroachment on the Wisconsin & Southern Railroad right of way regardless of whether or not that access or encroachment is on, under,

over, intentional or inadvertent, until such time as the Contractor provides satisfactory assurances and measures to prevent any reoccurrence of such violation.

#### **BID ITEM 10790 - RAILROAD INSURANCE**

The Contractor shall provide special third party protection insurance for, and in behalf of, the Wisconsin and Southern Railroad Company as well as the Union Pacific Railroad Company per Section 107.12(c) Railroad Insurance Requirements of the City of Madison Standard Specifications.

The amount of insurance to be provided shall be limited to a combined single limit amount of Two Million Dollars (\$2,000,000) per occurrence for Bodily Injury Liability, Property Damage Liability, and Physical Damage to Property, with Six Million Dollars (\$6,000,000) aggregate for the term of the policy with respect to Bodily Injury, Liability, Property Damage Liability and Physical Damage to Property.

#### **SECTION 108.2      PERMITS**

The City of Madison has submitted a DNR Sanitary Sewer Submittal, a Dane County Zoning Permit, and has submitted a WISDOT DT2036 Railroad permit.

The City will apply for the railroad permit from WISDOT and WSOR. Contractor shall be responsible for adhering to any and all the conditions of the approved WISDOT DT2036 permit.

The Contractor shall be responsible for applying for and obtaining a Permit for Utility Construction in Town of Blooming Grove's Right-of-Way. The Contractor shall also be responsible for contacting the Town of Blooming Grove Building Inspector, Roger Schrader at 414-639-6314, for inspection of the new building enclosure.

The City's obtaining these permits is not intended to be exhaustive of all permits that may be required to be obtained by the Contractor for construction of this project. It shall be the responsibility of the Contractor to identify and obtain any other permits needed for construction, including any permits needed for gas and electric services.

The Contractor shall meet the conditions of all permits. They shall install and maintain the erosion control measures shown on the plans, specified in these Special Provisions, or as directed by the City Construction Engineer or designees. This work will be paid for under the appropriate contract bid items or, if appropriate items are not included in the contract, shall be paid for as Extra Work. A copy of the permit is available at the City of Madison, Engineering Division office.

This permit covers trench dewatering to a maximum of 70 gallons/minute from the project, provided appropriate control measures are in place.

#### **SECTION 109.2      PROSECUTION OF WORK**

The Contractor shall begin work on or before **NOVEMBER 15, 2021**. The total time for completion of this contract is **THREE HUNDRED AND FORTY (340) CALENDAR DAYS**.

Work shall begin only after the start work letter is received. The Contractor shall notify the City Engineer three (3) weeks in advance of the selected start date. If it is desirable to begin work before the above-mentioned date, the Contractor shall establish a mutually acceptable date with the City Engineer. The Contractor shall limit workdays to 7:00 A.M. to 7:00 P.M.

#### **ARTICLE 500      SEWER AND SEWER STRUCTURES GENERAL**

##### **SANITARY SEWER GENERAL**

This project shall include renovating of an existing lift station as called for on the plans as well as installing approximately 126 linear feet of Cured-In-Place-Pipe (CIPP) lining at sizes and locations that

are specified on the plan set and in accordance with the Standard Specifications. This CIPP lining shall be paid for under BID ITEM 90071 – CIPP SANITARY SEWER FORCE MAIN – 8 INCH

**It is advised that the Contractor visit the site prior to bidding to determine the type of bypass setup, CIPP setup, and traffic control will be necessary for CIPP pipe lining.**

### **BID ITEM 90070 – SANITARY SEWER LIFT STATION**

#### **DESCRIPTION**

This work shall include, but not necessarily be limited to, site clearing and grubbing, demolition of existing lift station building, removal of existing lift station components, salvaging existing equipment, installation of the lift station, furnishing electrical service equipment and installation, lift station site grading, crushed stone, base course, concrete slabs, connection to force main and to sanitary sewer, restoration of the site, and furnishing all labor, tools, supplies, materials, equipment and any and all items necessary to provide a complete and properly operating lift station in accordance with the Plans, Special Provisions, and City of Madison Standard Specifications for Public Works Construction Latest Edition.

AFTER COMPLETION OF THE PROJECT AND BEFORE THE COMPLETED LIFT STATION IS CONSIDERED ACCEPTED, THE CONTRACTOR SHALL PROVIDE THE CITY WITH A GENERAL COST BREAKDOWN OF THE OVERALL PROJECT COSTS FOR THE CITY TO DETERMINE COST TO DEPRECIATE THE LIFT STATION ASSET. THE COST BREAKDOWN SHALL INCLUDE THE COSTS FOR THE FOLLOWING CATEGORIES: 1. PUMPS/PUMP CONTROLS, 2) TELEMETRY, 3) BUILDING, 4) WET WELL REHABILITATION, AND 5) GENERATOR.

#### **MEATHOD OF MEASUREMENT**

SANITARY SEWER LIFT STATION shall be measured LUMP SUM for all work complete and accepted.

#### **BASIS OF PAYMENT**

SANITARY SEWER LIFT STATION, as provided above, shall be paid for at the contract price which shall be full compensation for all site clearing and grubbing, excavation for the lift station structures (valve vault and wet well) and lift station piping, removal of existing lift station, salvaging existing equipment, construction of the lift station including but not limited to pumps, piping, valves, controls, all fees and costs required to provide electrical and gas service to the lift station site, electrical service equipment, lift station site grading, base course, concrete slabs, connection to force main and to sanitary sewer, restoration of the site, and furnishing all labor, tools, supplies, materials, equipment and any and all items necessary to provide a complete and properly operating lift station and to complete the work in accordance with the Specifications and Plans. The cost of furnishing, installing, and renovating the Sanitary Sewer Lift Station shall be included in the "Sanitary Sewer Lift Station" lump sum bid item.

### **BID ITEM 90071 – CIPP SANITARY SEWER FORCE MAIN – 8 INCH**

#### **DESCRIPTION**

This work shall consist of providing and installing Cured-In-Place-Pipe (CIPP) in the existing 8" cast iron force main from the lift station dry well to the end of the force main at a sewer access structure located in Fair Oaks Avenue, south east of the lift station location as shown on the plans This shall include all necessary materials, equipment, labor, material submittals and any and all items necessary to complete the work in accordance with the Plans, Special Provisions, and Article 509 of the City of Madison Standard Specifications for Public Works Construction Latest Edition. There is a 90 degree elbow in the receiving manhole where the force main connects in Fair Oaks Ave (City SAS#6238-003) that will likely need to be removed in order to complete force main linings. Reinstallation of the elbow or the installation of a ductile iron or AWWA C900 DR 18 with a mechanical joint to connect to the force main shall be considered incidental to this lining work.

### Pre-Lining Submittals

The Contractor shall at least two weeks prior to the planned start of construction, deliver the submittals designated in Section 509.3 and these Special Provisions to the Engineer. The Engineer will review the required submittals and respond to the Contractor in writing within two weeks of receipt. Submittals to the Engineer shall be electronic (unless specified otherwise) and delivered to the Project Engineer.

It is the Contractor's sole responsibility to obtain approval for all required submittals identified in this contract; no claim shall be made against the City of Madison if authorization to proceed is not granted due to unsatisfactory submittals.

CIPP lining of the force main may not begin until the submittal package is accepted in writing by the Engineer.

#### CIPP Product Data:

1. Manufacturer's product literature and application, installation and recommended repair (patching) requirements for materials used in liner.
2. Manufacturer's product certification of conformance to ASTM Standards for materials used in liner.
3. Manufacturer's certification, identifying the Contractor as a licensed installer and list of at least five successfully completed projects of similar scope
4. CIPP liner design and thickness calculations prepared and stamped by a Professional Engineer
5. Submit digital video of cleaned pipes in pre-lining condition.
6. Sewage bypass plan
7. Traffic control plan

### Post Lining Submittals

Prior to acceptance of the CIPP liner, the Contractor shall submit the following.

1. Manufacturer's wet out report with resin material quantities for the tube to be installed
2. Copy of CIPP field curing data log
3. Copy of hydrostatic pressure testing log and test results
4. Post installation CCTV recording and related reports in the form of a USB drive or downloadable files
5. Physical product samples from the liner segment installed in accordance with Section 509.7 of the City of Madison Standard Specifications for Public Works Construction Latest Edition

### Design Parameters

The structural CIPP wall thickness shall be in accordance with the Design Equations in Appendix XI of ASTM F 1216 and shall be based on the physical properties shown in Section 509.5(d) of the City of Madison Standard Specifications for Public Works Construction. In addition to the properties shown in Section 509.5(d) the following properties shall also be used for the design of the liner:

1. Existing Condition: Fully Deteriorated Pressure Pipe
2. Depth to pipe invert: 10-feet
3. Soil Modulus: 700 psi
4. Soil Unit Weight: 120 pcf minimum
5. Groundwater Level: 2 feet below surface
6. Live Loads: Cooper E80 Railroad Live Loading
7. Internal Operating Pressure: 150 psi

The CIPP liner design and thickness calculations are to be prepared and stamped by a Professional Engineer actively licensed in the State of Wisconsin and submitted to the Engineer.

### Cleaning

Remove all internal debris from the pipeline that interfere with the CIPP liner installation. Pipes shall be adequately cleaned with high-velocity jet cleaners, mechanically powered equipment; cable-attached devices, drag scraping and/or fluid-propelled devices.

The cleaning method shall remove all rust, scales, tuberculation, deposits, loose or deteriorated remains of any original coatings and other foreign materials from the inside of the pipe so as to produce a smooth metal surface finish that will allow the new CIPP liner to adhere and securely bond to the existing host pipe.

Verification of the readiness to install the liner shall be performed by experienced personnel trained in locating breaks, obstacles, etc. This will include the use of closed-circuit television (CCTV) and possibly also include pipe mandrels and other devices. The interior of the pipeline shall be carefully inspected to determine the location of any conditions that may prevent proper installation of the CIPP liner. These conditions shall be noted and brought to the attention of the Engineer so that they may be corrected. Copies of the CCTV inspection videos and related reports shall be made available to the Engineer, in the form of a USB drive or downloadable files, as soon as possible for review and approval prior to commencement of lining activities.

### Testing

In addition to the testing requirements stated in Section 509.7 of the City of Madison Standard Specifications for Public Works Construction, the Contractor shall perform a hydrostatic pressure test per ASTM F1216, Section 8.3. Any trapped air shall be removed and the CIPP liner shall be stabilized prior to beginning hydrostatic pressure testing.

Contractor shall perform hydrostatic pressure test on the lined force main at a hydrostatic pressure of twice the working pressure or at the working pressure plus 50 psi, whichever is less.

After the one-hour test, the quantified make up water shall be calculated and if the loss at the test pressure exceeds what is acceptable (up to 20 gallons per inch diameter, per mile, per day) identify the source of the loss and minimize it in a manner acceptable to the Engineer.

### Existing Conditions

We have very limited CCTV data for the force main being lined. The videos of the force main are available online at the following website. This information has been made available to you for bidding purposes. In order to access the videos online, enter the following on your Microsoft Internet Explorer address bar:

<ftp://ftp.cityofmadison.com>

Enter the following at the prompt:

Username: sewervideos

Password: Watch47!

Select the folder: sewervideos\Thurber Lift Station

If you are not prompted, go to the File menu and select Login As and use the same username and password combination above.

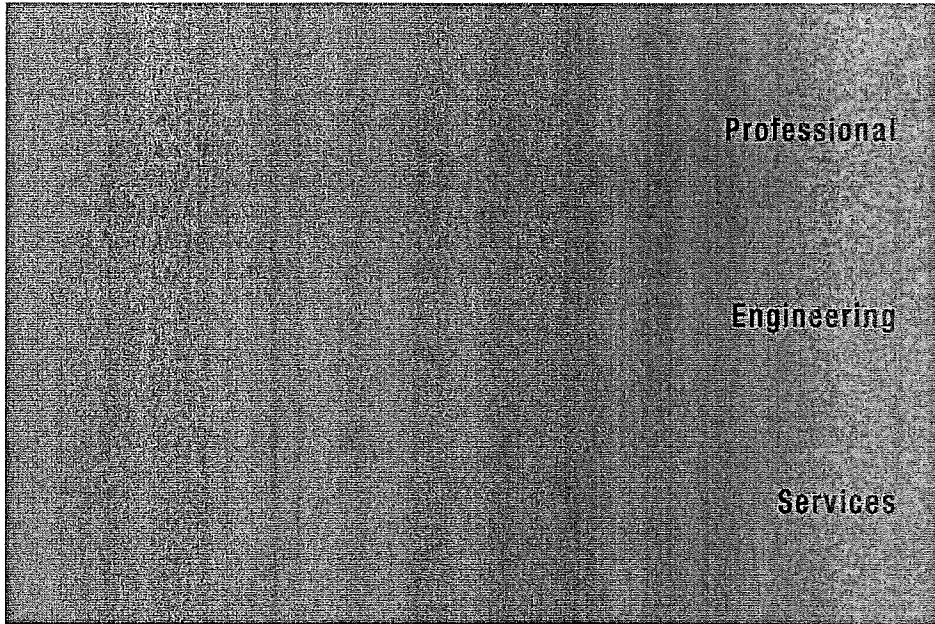
### **METHOD OF MEASUREMENT**

CIPP SANITARY SEWER FORCE MAIN – 8 INCH shall be measured by the linear foot for work completed and accepted in accordance with Article 509 of City of Madison Standard Specifications for Public Works Construction Latest Edition.

### **BASIS OF PAYMENT**

CIPP SANITARY SEWER FORCE MAIN – 8 INCH, as provided above, the contract unit price shall include furnishing all equipment, tools, labor, and materials; televising existing sanitary force main before and after liner installation; cleaning existing sewer force main prior to lining; placing cured-in-place-pipe; bypassing sanitary sewerage around the section undergoing lining; cleaning the site and all other general requirements and incidental work pertaining necessary to complete the CIPP work in accordance with the Plans, Special Provisions, and Article 509 of the City of Madison Standard Specifications for Public Works Construction Latest Edition.





Thurber  
Lift Station  
Replacement

Project 11672  
Contract 9063



# Technical Specifications

City of Madison, WI

Issued for Bid

August 19, 2021



TECHNICAL SPECIFICATIONS  
THURBER LIFT STATION REPLACEMENT  
PROJECT 11672  
CONTRACT 9063  
CITY OF MADISON, WISCONSIN



*Andrew B. Constant*

8/19/21

Prepared by:

STRAND ASSOCIATES, INC.®  
910 West Wingra Drive  
Madison, WI 53715  
[www.strand.com](http://www.strand.com)

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## **SPECIFICATIONS**

SECTION 01 11 00  
SUMMARY OF WORK

PART 1—GENERAL

1.01 DIVISION ONE

- A. The requirements of Division 01 apply to all sections of the Contract(s).

1.02 PROJECT SCOPE

- A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes, and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

1.03 CONTRACT DOCUMENTS—INTENT AND USE

A. Intent of Documents:

1. Singular notations and specifications shall be considered plural where application is reasonably inferred.
2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications not referenced in individual sections shall apply as required for proper performance of the Work.
4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from ENGINEER.

B. Use of Documents:

1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
2. CONTRACTOR shall use all of the Project Drawings and Specifications:
  - a. For a complete understanding of the Project.
  - b. To determine the type of construction and systems required.
  - c. For coordination with other contractors.
  - d. To determine what other work may be involved in various parts or phases.
  - e. To anticipate and notify others when work by others will be required.
  - f. And all other relevant matters related to the project.
3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work as may be shown or inferred by the entire set of Project Drawings and Specifications.

## 1.04 CONSTRUCTION REQUIREMENTS

### A. General Information and Requirements:

1. Wastewater pumping during construction must be continuous and the pumping efficiency must be equal to that achieved prior to the start of construction.
2. It shall be the responsibility of CONTRACTOR to not in any way impair the normal operating efficiency of the facilities, regardless of the work underway. No bypassing of raw or partially treated wastewater to receiving stream shall occur at any time as a result of construction. In general, this requires that new facilities be complete and ready for service or that temporary facilities be provided prior to removing existing units from service for modification or repair. CONTRACTOR shall provide all temporary piping, bypass pumping, and temporary construction required to complete the Work.
3. Operation of existing treatment facilities will be the responsibility of OWNER. CONTRACTOR shall cooperate with OWNER's staff at all times. A minimum of 48 hours prior to making any process or electrical connections to existing facilities or modification or demolition of existing facilities, CONTRACTOR shall notify OWNER in writing. At the time of notification, CONTRACTOR shall submit a schedule for completion of the Work, including a description of measures that will be taken to minimize the impact to existing facilities.
4. Access: CONTRACTOR shall maintain roadways open at all times to meet OWNER's requirements. CONTRACTOR shall be responsible for maintaining roadways in drivable condition, including placement of temporary stone and gravel and providing drainage as necessary. All city-owned roadways around the facility shall be cleaned of construction site materials, soil, and debris as necessary.
5. In addition to requirements listed elsewhere in these specifications, when flow diversion is necessary or when the pumping station is taken offline, temporary pumping or trucking shall be provided. As a minimum, CONTRACTOR shall include temporary pumps and generators capable of pumping the firm capacity flow of 350 gpm. Firm capacity is defined as a pump or pumps capable of handling the listed flow with the largest unit out of service. CONTRACTOR shall provide an additional generator in addition to the temporary pumps and generators required above. When flow diversion is in progress, CONTRACTOR shall have a minimum of one worker dedicated full time to operate the pumps. OWNER reserves the right to delay the start of flow diversion due to operation concerns, wet weather, or storms.
6. Existing shutoff valves and gate valves may not provide a watertight seal, and should not be assumed to be in a functional operating condition to divert flow.

### B. Construction Sequence:

1. The following construction sequence is provided as a general guideline for the information and for the benefit of CONTRACTOR. This construction sequence is not intended to dictate means, method of construction, or direct construction activities. This construction sequence is a conceptual general construction sequence with minimum recommended outage, shutdowns, and operating units to be maintained in service. The general construction sequence is projected to allow the Work to be completed while maintaining pumping operations at the station. It is not intended to be all inclusive and does not list all work elements or details that are required to complete the Work. CONTRACTOR shall be responsible for implementing any additional details required, including temporary piping, bypass pumping, or temporary construction at no additional cost to OWNER.



2. CONTRACTOR may propose alternate sequence or modifications to this sequence. OWNER will review the proposed modification and determine if such modification of the sequence interferes with the proper operation of the pumping station. Any modifications to this general construction sequence shall be proposed in writing and shall be approved by OWNER prior to their implementations.
- C. Thurber Avenue Pumping Station Construction Sequence:
1. Prior to installation of the bypass pumping and diverting flow around the station, the bypass pumping system plan shall be sent in writing to OWNER for review and approval.
  2. The bypass pumping plan shall contain, at a minimum, pumps of sufficient size such that with the largest unit out of service, the pump(s) can deliver 350 gpm to the discharge connection. To provide pumping in the situation of a power outage, either engine-driven pumps or two generators each capable of powering all pumps shall be included.
  3. Following OWNER approval, the bypass pumping system pumps and suction piping shall be installed in the influent manhole.
  4. Once the pump(s) and suction piping are installed, provisions should be implemented that would provide for pumps to be installed in the influent manhole and arrangements for tanker trucks to be on site during the initial station shut down. The pumps and tanker trucks would allow for pumping and trucking flow to a MMSD approved site for discharge should the time needed for the station shut down exceed the time allowable before a backup.
  5. During a period of low flows, the station would be taken off line, the pumping/trucking implemented, and a tee installed in the existing dry well on the discharge force main. On the branch of the tee is a shut off valve. Following installation, the station should be placed back on line with the valve on the new tee in the closed position.
  6. Piping would be extended from the new shut off valve up through the floor of the existing station and out through the wall of the existing building. This line will provide the ability to bypass pump from the influent manhole into the existing force main and thus allow the existing station to be taken off line for construction. The bypass pumping should include two pumps each capable of handling the design flow of 350 gpm with provisions for emergency power. If engine driven pumps would be used, two engine driven pumps each capable of handling the design flow would be provided.
  7. With the bypass pumps installed and functioning, the existing building, pumps, controls, piping, valves, etc. can be demolished. The wet well would be modified to install new base flanges, guide rails, discharge piping and associated appurtenances. The existing dry well can be filled in up to the new elevation of the proposed valve vault. New piping and valves installed and connected to the existing force main. New entry into the valve vault would be installed.
  8. The new building along with the generator, controls, floats, and associated appurtenances would be installed.
  9. The station would be started up and tested. Following successful testing, the bypass pumping would be discontinued and the new station placed on line.
  10. The remaining contractual items would be completed and the project closed out.

## 1.05 CONTRACTOR USE OF SITE

- A. General:
1. The "area of the site" referred to in these Specifications shall be as shown on the Drawings. If the "area of the site" is not shown, OWNER's property lines, the Project right-of-way and/or any easements obtained for the Project shall be considered the "area of the site."
  2. Construction activities shall be confined within the "area of the site" limits.

3. From the start of work to completion CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work, to the conditions which previously existed.
5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

B. Parking and Deliveries:

1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER.
3. Access to the site for delivery of construction material or equipment shall be subject to approval of OWNER.

1.06 EXISTING SERVICES, OVERHEAD UTILITIES, AND UNDERGROUND FACILITIES INCLUDING STRUCTURES

- A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security will not be permitted throughout construction. CONTRACTOR shall provide temporary facilities as needed to maintain services.
- B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.
- C. Work shall not commence until all labor, materials, and equipment are available so Work can continue without interruption or delay.
- D. Should uncharted or incorrectly charted services or Underground Facilities be encountered during installation, notify OWNER and consult with utility owner immediately.
- E. Cooperate with OWNER and utility companies in keeping respective services and Underground Facilities in operation and repair any damage.
- F. CONTRACTOR shall not interrupt existing services and Underground Facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.
- G. Any accidental interruption of services and Underground Facilities shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.
- H. Wisconsin Statute 182.0175(2) requires, among other provisions, that before excavation or demolition begins, reasonable advance notice not less than three working days prior to the start of the excavation or demolition of the intent to excavate or demolish and the commencement date be provided to the owners of the Underground Facilities in and near the construction area whose facilities may be affected by the excavation or demolition. As part of this notification requirement, CONTRACTOR shall contact Digger's Hotline (811 or 1-800-242-8511). CONTRACTOR shall be aware that not all owners participate in the Digger's Hotline program. A call to this agency shall not absolve CONTRACTOR of the

requirements of this statute. CONTRACTOR shall comply with all other provisions of the statute though not enumerated herein.

- I. Locations and elevations of services and Underground Facilities as shown on the Drawings are approximate. It shall be CONTRACTOR's responsibility to determine their exact location when in their vicinity. To this end, CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of services and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such services and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.
- J. Where potential grade conflicts might occur with existing services and Underground Facilities, CONTRACTOR shall uncover such services and Underground Facilities sufficiently in advance of construction so that elevations may be determined to allow any necessary adjustments to be made.
- K. CONTRACTOR shall coordinate with overhead utility companies prior to the Work. CONTRACTOR shall provide all necessary temporary and permanent support relocation or temporary and permanent restraint to maintain overhead utilities in service.
- L. CONTRACTOR shall keep an accurate and complete record of all such services and Underground Facilities encountered and shall provide OWNER a copy of this record. The record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.
- M. CONTRACTOR shall inspect all services and Underground Facilities for condition and soundness. Unsound conditions shall be reported to OWNER immediately after exposing. CONTRACTOR shall not proceed with the Work until the service or facility owner has been notified. Service or facility owner shall then be given time to inspect and correct, if required, the service or Underground Facility. CONTRACTOR may make claim under the provisions of Articles 11 and 12 of the General Conditions should CONTRACTOR feel a price or time adjustment is justified.
- N. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing services and Underground Facility encountered shall be paid for by CONTRACTOR.
- O. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing services and Underground Facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is required to perform additional Work in making the explorations and excavations, extra compensation will be allowed as provided for in the General Conditions.

#### 1.07 PROTECTION OF WORK AND IMPROVEMENTS

- A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.
- B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.

- C. CONTRACTOR shall keep property, existing improvements, and the Work including structures, mains, fittings, and accessories free from dirt and foreign matter at all times.
- D. CONTRACTOR shall provide temporary plugging of openings, holes, and pipe ends that are existing or that CONTRACTOR has installed.
- E. Property, improvements, and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.
- F. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall replace all roads, shoulders, and paved areas damaged during the project in accordance with this section. Gravel shoulders, gravel roads, and parking areas shall be repaired in accordance with Section 32 11 23–Aggregate Base Course.

1.08 AVAILABILITY OF LANDS

- A. Easements were not obtained for this Project. CONTRACTOR shall confine its operations, equipment and storage areas to the lands and rights-of-way in which the Project is to be located. CONTRACTOR may enter into written agreements with property owners for use of other lands during construction. Copies of such agreements shall be provided to OWNER.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 29 00

CONTRACT CONSIDERATIONS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Cash allowances.
  - 2. Measurement and Payment-Lump Sum.

1.02 CASH ALLOWANCES

- A. Cash allowances are not included in this project. All costs for concrete surface repair, electrical service installation, unsuitable foundation material, and natural gas service installation shall be included in the lump sum price bid. Refer to the sections below for more information of these items.

Concrete Surface Repair	Section 03 01 30-Concrete Surface Repair
Electrical Service	Section 26 21 00-Electrical Service System
Unsuitable Foundation Material	Section 31 23 00-Excavation, Fill, Backfill, and Grading
Natural Gas Service	Section 33 52 16-Fuel Gas Distribution Utilities

1.03 MEASUREMENT AND PAYMENT-LUMP SUM

- A. Payment for Lump Sum projects will be based on the accepted schedule of values for the project.
- B. An acceptable schedule of values will include the following features:
  - 1. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction. Schedule shall be subdivided as necessary by specification section and work area.
  - 2. Identify each line item with the number and title of the respective Specification Section.
  - 3. For each major line item list sub-values of major products or operations under the item.
  - 4. For the various portions of the work:
    - a. Each item shall include a directly proportional amount of CONTRACTOR's overhead and profit.
    - b. For items on which progress payments will be requested for stored materials, break down the value into:
      - (1) The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by ENGINEER.
      - (2) The total installed value.
  - 5. The sum of all values listed in the schedule shall equal the total Contract Sum.
  - 6. Schedule shall include a separate listing of general items such as bonds, insurance, mobilization, demobilization, field supervision, and record documents.

- C. Once a schedule of values is accepted, it shall not be revised, except for changes associated with subsequently executed change orders.
- D. No separate measurement for payment will be performed for Lump Sum Work.
- E. CONTRACTOR shall estimate percentage of Work completed. ENGINEER will review CONTRACTOR's estimate of quantity of Work completed.
- F. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.
- G. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings shall be included in the Lump Sum Bid.
- H. Some technical specification sections may include payment provisions. These provisions are in addition to the provisions of this section which apply to all of the Work.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 31 00

### COORDINATION, FIELD ENGINEERING, AND MEETINGS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Coordination.
  - 2. Field engineering.

##### 1.02 COORDINATION

- A. CONTRACTOR shall coordinate scheduling, submittals, and work to provide an efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

##### 1.03 FIELD ENGINEERING

- A. CONTRACTOR shall locate and protect property stakes, legal survey monuments, benchmarks, and survey control and reference points. CONTRACTOR shall pay for replacement of disturbed property stakes and legal survey monuments by a Registered Land Surveyor acceptable to OWNER and for replacement of benchmarks and survey control and reference points provided by ENGINEER.
- B. CONTRACTOR shall provide field engineering services as required to establish elevations, lines, and levels utilizing recognized engineering survey practices.
- C. CONTRACTOR shall furnish all required plummets and graduated poles to check all Work.
- D. If stakes and boards have to be reset because of negligence of CONTRACTOR, CONTRACTOR shall bear the cost of such work.
- E. If laser beam is used, CONTRACTOR shall check its Work against intermediate grade stakes provided between manholes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- F. If existing property stakes not within the limits of the trench are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.
- G. CONTRACTOR shall be responsible for all lines, elevations, and measurements of buildings, structures, piping, utilities, and other work executed by CONTRACTOR under the Contract. CONTRACTOR must exercise proper precaution to verify figures before laying out the Work and will be held responsible for any error resulting from its failure to exercise such precaution.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION



## SECTION 01 33 00

### SUBMITTALS

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
  - 2. To facilitate CONTRACTOR's understanding of the design intent, procedures have been established for advance submittal of design data and for its review or rejection by ENGINEER.
  - 3. The type of submittal requirements specified in this section include construction progress schedule, submittal schedule, shop drawings, product data, samples, maintenance manuals, and other miscellaneous work-related submittals.
- B. Related work described elsewhere: More detailed requirements for submittals are described in other sections of these specifications for some materials and equipment. They are to be considered additional requirements to supplement the requirements specified in this section. Submittals shall conform to Article 7 of the General Conditions.
- C. Definitions: "Electronic Submittal" is defined as any submittal transmitted electronically to ENGINEER for review.

##### 1.02 IDENTIFICATION OF SUBMITTALS

- A. CONTRACTOR shall completely identify each submittal and resubmittal by showing at least the following information:
  - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
  - 2. Name and location of project and identification number.
  - 3. Drawing number and specifications section number to which the submittal applies.
  - 4. Include the date of each submittal or resubmittal.

##### 1.03 GROUPING OF SUBMITTALS

- A. Unless otherwise specifically permitted by ENGINEER, CONTRACTOR shall make all submittals in groups containing all associated items so that information is available for checking each item when it is received.
- B. Partial submittals may be rejected as not complying with the provisions of the Contract Documents.

##### 1.04 TIMING OF SUBMITTALS

- A. CONTRACTOR shall make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary approval, for possible revision and resubmittal, and for placing orders and securing delivery.

- B. The review period for submittals that are received after 3 P.M. shall commence on the following business day.

#### 1.05 CONSTRUCTION PROGRESS AND SUBMITTAL SCHEDULES

- A. Submit preliminary schedules within 10 days of the effective date of the Agreement.
- B. Revise schedules incorporating any comments provided at the schedule review conference required in GC.2.05 and resubmit.
- C. As a minimum, the construction progress schedule shall consist of a horizontal bar chart with a separate line for each major portion of Work or operation, identifying first workday of each week.
- D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration for each activity. Identify activities that are on the critical path.
- E. Include line items for milestones (if any), Substantial, and Final Completion.
- F. Submit updated schedules with each Application for Payment, identifying changes since previous version.
- G. Indicate estimated percentage of completion for each item of Work at each submission.
- H. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

#### 1.06 SHOP DRAWINGS

- A. Shop drawings shall include specially prepared technical data for this project including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements, and similar information not in standard printed form for general application to a range of similar projects. Shop drawings shall be submitted for all manufactured or fabricated items. See individual technical sections for special requirements.
- B. CONTRACTOR shall make all shop drawings accurately to scale and sufficiently large to show all pertinent aspects of the item and its method of connection to the work.
- C. Shop drawings shall be checked, approved, and stamped by CONTRACTOR in accordance with the General Conditions before transmittal to ENGINEER for review and approval.
- D. Complete shop drawings and descriptive data shall be submitted on all manufactured or fabricated items prior to 50% completion of the Work. Applications for payment beyond 50% of the Contract amount will not be recommended for payment until all shop drawings are submitted, including the required hard copies, or a revised schedule for any remaining submittals is agreed to by OWNER and ENGINEER.

- E. CONTRACTOR shall submit shop drawings following the electronic submittal procedure described below. If electronic submittal is impossible, CONTRACTOR may request ENGINEER to review hard copy submittals on a limited basis. ENGINEER may request to review hard copy submittals on a limited basis for submittals that are over 100 pages in length. If ENGINEER agrees to or requests hard copy submittal review, CONTRACTOR shall submit six color copies of shop drawings and descriptive data to ENGINEER for approval. Three copies of these will be returned to CONTRACTOR if approved. If shop drawings are not approved or if they are stamped "Approved as Noted-Resubmit," two corrected copies will be returned to CONTRACTOR for use in resubmittal. If CONTRACTOR desires more than three approved copies, submitted quantity shall be increased accordingly.
- F. Shop drawings submitted to ENGINEER will be reviewed and stamped "Approved," "Approved as Noted," "Approved as Noted-Resubmit," or "Not Approved." CONTRACTOR shall resubmit the above number of corrected shop drawings for all shop drawings stamped "Approved as Noted-Resubmit" and "Not Approved" and will continue this process until shop drawings are stamped "Approved" or "Approved as Noted." If drawings are stamped "Approved as Noted-Resubmit," fabrication may proceed in accordance with the marked-up shop drawings. Installation shall not proceed until shop drawings have been resubmitted and stamped "Approved" or "Approved as Noted."
- G. If shop drawings are stamped "Approved as Noted" or "Approved as Noted-Resubmit" and CONTRACTOR does not agree with revisions or cannot conform with revisions, fabrication shall not proceed and shop drawings shall be resubmitted with explanation of CONTRACTOR's position.
- H. All shop drawings used for construction site activities shall bear the "Approved" or "Approved as Noted" stamp of ENGINEER.
- I. Arrangements may be made between CONTRACTOR and ENGINEER to provide additional copies of "Approved" shop drawings for field activity purposes.
- J. PDF Submittal Procedures:
  - 1. Summary:
    - a. Shop drawing and product data submittals shall be transmitted to ENGINEER in electronic (PDF) format.
    - b. The intent of PDF submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
    - c. The PDF submittal process is not intended for color samples, color charts, or physical material samples.
  - 2. Procedures:
    - a. CONTRACTOR shall review and apply a stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.
    - b. CONTRACTOR shall transmit each cover letter and submittal to ENGINEER as an e-mail attachment.
    - c. ENGINEER will return the reviewed shop drawing via e-mail with a transmittal letter, after review, indicating the status of the shop drawing review.
    - d. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of CONTRACTOR.

- e. Electronically submitted shop drawings shall follow the following format:
  - (1) All files shall be delivered in PDF format with a minimum resolution of 300 dpi unless otherwise requested by ENGINEER. Scanned in material shall be scanned in color and any markings by CONTRACTOR shall be made in red. Pages shall be rotated to the appropriate position for easy reading on a computer monitor such that the majority of text is vertical.
  - (2) Files shall be delivered without security features activated.
  - (3) Shop Drawings shall be uploaded as individual files. Files combined into a zip drive are not acceptable. All pages of one submittal should be contained in one file.
  - (4) The file shall open to a cover page containing, at a minimum, the following information:
    - (a) CONTRACTOR's stamp.
    - (b) Name, e-mail, and telephone number of the individual who may be contacted for further information.
    - (c) Project number.
    - (d) Submittal number.
    - (e) Submission date, if resubmittal, all previous submission dates.
    - (f) Index detailing contents and the total number of pages in the submittal.
- f. Once a shop drawing has been "Approved" or "Approved as Noted," CONTRACTOR shall provide three hard color copies of the "Approved" or "Approved as Noted," shop drawings to ENGINEER. CONTRACTOR is responsible for the hard copy color replication of ENGINEER's "Approved" or "Approved as Noted," shop drawings for use by CONTRACTOR. Hard copy shop drawings shall be submitted in 3-ring binders or 3-tab report covers.

K. Shop drawings shall include verification that the item meets applicable codes and standards.

#### 1.07 COLORS AND PATTERNS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product, CONTRACTOR shall submit accurate color charts and pattern charts to ENGINEER for OWNER's review and selection.
- B. Unless all available colors and patterns have identical wearing capabilities and are identically suited for the installation, CONTRACTOR shall completely describe the relative capabilities of each.

#### 1.08 SAMPLES AND FIELD MOCKUPS

- A. CONTRACTOR shall provide samples and field mockups where noted or specified.
- B. Samples are physical examples which illustrate materials, equipment, or workmanship and establish standards by which the work will be judged.
- C. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product and full range of color, texture, and pattern.
- D. Samples shall have labels firmly attached, bearing the following information:
  - 1. Name of project.
  - 2. Description of product and finish.

3. Name of CONTRACTOR.
  4. Trade name and number of product.
  5. Standards met by the product.
- E. Approval of samples must be obtained prior to proceeding with any work affected by material requiring sample approval.
- F. Samples, unless otherwise noted, become the property of OWNER.
- G. In situations specifically approved by ENGINEER, the retained sample may be used in the construction as one of the installed items.
- H. Field Mockups:
1. CONTRACTOR shall erect field mockups at the project site in a location acceptable to ENGINEER and OWNER.
  2. When accepted by ENGINEER, the mockup will become the basis for comparison of the actual work.
  3. Remove mockup at conclusion of the work if it was not incorporated into the work.

#### 1.09 PRODUCT DATA

- A. CONTRACTOR shall provide product data as required to supplement shop drawings.
- B. Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by CONTRACTOR to illustrate a material, product, or system for some portion of the work.
- C. CONTRACTOR shall collect required product data into one submittal for each unit of work or system.
- D. CONTRACTOR shall include manufacturer's standard printed recommendations for application and use, compliance with standards, performance characteristics, wiring and piping diagrams and controls, component parts, finishes, dimensions, required clearances, and other special coordination requirements.
- E. CONTRACTOR shall mark each copy of standard printed data to identify pertinent products, models, options, and other data.
- F. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

#### 1.10 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by ENGINEER.
- B. Shop Drawings and Product Data:
1. Revise initial drawings or data and resubmit as specified for initial submittal.
  2. Itemize in a cover letter any changes which have been made other than those requested by ENGINEER.
- C. See SC-7.16 for additional information regarding resubmittals.

## 1.11 MANUFACTURER'S DIRECTIONS

- A. Manufactured articles, materials, and equipment shall be stored, commissioned, operated, applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer, unless specified to the contrary.
- B. Wherever specifications call for work to be performed or materials to be installed in accordance with the manufacturer's printed instructions or directions, CONTRACTOR shall furnish copies as required for shop drawings of those instructions or directions to ENGINEER before installing the material or performing the work.

## 1.12 MAINTENANCE MANUAL

- A. Prior to 75% completion of the Contract or at a minimum of 45 days prior to the scheduled start-up date of any individual item of equipment, whichever is earlier, CONTRACTOR shall furnish to ENGINEER four complete copies of a maintenance manual for all equipment furnished. Applications for payment beyond 75% of the contract amount will not be recommended for payment until all maintenance manuals are submitted or a revised schedule for remaining maintenance manuals is agreed to by OWNER and ENGINEER.
- B. The manuals shall include manufacturer's instructions for maintenance and operation for each item of mechanical and electrical equipment. Manuals shall be specific for the equipment as installed; provide project specific inserts as required. Manuals shall contain: operation instructions, lubrication schedules, types and quantities, preventative maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and startup procedures and, where applicable, test data and curves.
- C. CONTRACTOR is responsible for producing an electronic version of the Equipment Operations and Maintenance (O&M) Manuals Manual. The Electronic Equipment O&M Manual shall be delivered in Portable Document Format (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 CONTRACTOR shall provide all Equipment O&M Manuals in the electronic format as defined below.
- D. The filename for the Equipment O&M Manual submittal will be provided with the request for final Equipment O&M Manuals. Filenames use the "eight dot three" convention (XX XX XX\_YY.PDF) where XX XX XX is the specification section number and YY is an ID number. No one file shall be larger than 10 MB. If technical problems require that the submittal be divided into more than one file, a letter extension shall be added to the end of each filename.
- E. 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.
- F. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document format (\*.PDF). 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 6 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.

- G. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.
- H. 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.
- I. Thumbnails shall be generated and embedded in each PDF file.
- J. Files shall be delivered without Security features activated. Password protected files will be unacceptable.
- K. 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
- L. 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.
- M. The submittal shall be delivered on CD after all Equipment O&M Manuals have been received and reviewed. Each CD shall be labeled, at a minimum, as follows:
  - 1. O&M title spelled out in complete words.
  - 2. Project and OWNER name.
  - 3. Month and date.
  - 4. Specification section number and title.
  - 5. Manufacturer name, point of contact, telephone number, and e-mail address as appropriate.
- N. CONTRACTOR shall reprocess any portion of the document that does not view or print to OWNER's satisfaction.
- O. CONTRACTOR is fully responsible for obtaining any and all copyright permissions associated with conversion of this information to electronic format.
- P. Each maintenance manual shall include a completed equipment maintenance summary form for each type and size of equipment being furnished that requires power, lubrication, or maintenance. Equipment Summary forms are located at the end of this section.

## PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION



EQUIPMENT MAINTENANCE SUMMARY FORM<sup>(1)</sup>

Equipment \_\_\_\_\_ No.: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Specification Section: \_\_\_\_\_  
Equipment Name: \_\_\_\_\_  
Building Name: \_\_\_\_\_ Room No.: \_\_\_\_\_  
Plant Location: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_  
Service Representative: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_ Fax: \_\_\_\_\_  
Make: \_\_\_\_\_ Model: \_\_\_\_\_  
Serial No.: \_\_\_\_\_ Type: \_\_\_\_\_  
Size: \_\_\_\_\_  
Equipment Speed: \_\_\_\_\_  
Capacity: \_\_\_\_\_  
Operating Range: \_\_\_\_\_  
Material: \_\_\_\_\_  
Alarms: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Drive Ratio: \_\_\_\_\_  
Motor Speed: \_\_\_\_\_ Service Factor: \_\_\_\_\_  
Volts: \_\_\_\_\_ Phase: \_\_\_\_\_ hp: \_\_\_\_\_ Efficiency: \_\_\_\_\_  
Motor Type: \_\_\_\_\_  
Motor Sensors: \_\_\_\_\_  
Motor Manufacturer: \_\_\_\_\_  
Model: \_\_\_\_\_ Motor Frame: \_\_\_\_\_  
Insulation Class: \_\_\_\_\_ FLA: \_\_\_\_\_ LRA: \_\_\_\_\_

(1) Complete as applicable; attach supplementary pages as necessary.

Maintenance Requirements  
(Use additional sheets if more space is needed.)

LUBRICATION

<u>Item</u>	<u>Generic Type of Lubricant</u>	<u>Supplier</u>	<u>Estimated Frequency</u>	<u>Annual Quantity</u>
-------------	--------------------------------------	-----------------	--------------------------------	----------------------------

PREVENTIVE MAINTENANCE

<u>Item</u>	<u>Action</u>	<u>Frequency</u>	<u>Reference</u>
-------------	---------------	------------------	------------------

SUGGESTED MINIMUM SPARE PARTS LIST

<u>Manufacturer</u>	<u>Part No.</u>	<u>Quantity Unit</u>	<u>Description</u>
---------------------	-----------------	----------------------	--------------------

The following information is included in O&M Manual:

Check or mark N/A

1. Recommended installation, adjustment, calibration, and troubleshooting. \_\_\_\_\_
2. Complete internal and connection wiring diagrams. \_\_\_\_\_
3. Complete parts lists, by generic title and identification number, with exploded views of each assembly. \_\_\_\_\_
4. Disassembly, overhaul, and reassembly instructions. \_\_\_\_\_
5. Recommended prestart checks. \_\_\_\_\_
6. Recommended start procedure. \_\_\_\_\_
7. Recommended shutdown procedure for both short and long term. \_\_\_\_\_
8. Recommended operating precautions that include safety for personnel and equipment. \_\_\_\_\_
9. Recommended standing maintenance procedure. \_\_\_\_\_

END OF SECTION

SECTION 01 41 00  
REGULATORY REQUIREMENTS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. OSHA requirements.
  - 2. Roadway limits.
  - 3. Permits.
  - 4. Wage rates.

1.02 OSHA REQUIREMENTS

- A. All work including site safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the "Occupational Safety and Health Act."

1.03 ROADWAY LIMITS

- A. CONTRACTOR shall comply with roadway weight restrictions including seasonal weight restrictions.

1.04 PERMITS

- A. The following permit is currently being obtained by OWNER: Wisconsin Department of Natural Resources Wastewater Pumping Station Permit.
- B. The permit will be shared once obtained. CONTRACTOR shall comply with all provisions of this permit and shall be responsible for notifications as required by this permit. CONTRACTOR shall obtain all other permits required for the Work. Where the requirements of any permit is more restrictive than the Drawings or the Specifications, the permit requirements shall govern.
- C. A building permit will be required from OWNER.
- D. Any permits required for dewatering operations shall be obtained and paid for by CONTRACTOR.
- E. For dewatering operations, if dewatering wells singly or in aggregate produce 70 or more gallons per minute, CONTRACTOR shall obtain from the Wisconsin Department of Natural Resources, in accordance with Paragraph 281.17(1), Wisconsin Statutes, a permit for dewatering. The Department's private water supply section's address for Well Permits is: Wisconsin Department of Natural Resources, Private Water Supply Section, Box 7921, Madison, Wisconsin 53707. All wells shall be drilled and closed in accordance with DNR requirements for installing and abandoning wells.

- F. CONTRACTOR shall comply with the provisions of Chapter 283, Wisconsin Statutes, regulating the discharge of effluent from construction pit trench dewatering. These provisions provide for the removal of suspended solids from dewatering effluent prior to the direct discharge to surface waters or wetlands. CONTRACTOR shall apply as necessary to the Department of Natural Resources for a permit to discharge effluent from construction pit or trench dewatering. This discharge may be covered by an existing state general permit for discharging contaminated stormwater runoff/or construction pit dewatering. Information about and application forms for this permit(s) may be obtained at the address shown below.

South Central Region:  
Department of Natural Resources  
3911 Fish Hatchery Road  
Fitchburg, WI 53711  
(608) 275-3266

1.05 WAGE RATES

- A. A wage rate determination is not a requirement of this Project.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 42 00

### REFERENCE STANDARDS AND DEFINITIONS

#### PART 1-GENERAL

##### 1.01 SUMMARY

###### A. Work Included:

###### 1. Reference Standards:

- a. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
- b. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is CONTRACTOR's responsibility to provide materials and workmanship which meet or exceed that specifically named code or standard.
- c. It is also CONTRACTOR's responsibility, when so required by the Contract Documents, to deliver to ENGINEER all required proof that the material or workmanship, or both, meet or exceed the requirements of the specifically named code or standard.

###### 2. Definitions:

- a. A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.
- b. Certain terms used in the Contract Documents are defined generally in this section to supplement definitions of the Agreement, General Conditions, Supplementary Conditions, and other general contract documents.
- c. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the Work.

- B. Related Work Described Elsewhere: The specific naming of codes or standards occurs on the Drawings and in other sections of these Specifications.

##### 1.02 QUALITY ASSURANCE

###### A. Familiarity with Pertinent Codes and Standards:

1. It is CONTRACTOR's responsibility to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.
2. When required by individual sections of these specifications, CONTRACTOR shall obtain a copy of each pertinent code or standard and maintain the copies at the job site during submittals, planning, and progress of the Work until Substantial Completion of the Work is attained.

###### B. Overlapping or Conflicting Requirements:

1. Where compliance with two or more industry standards or sets of requirements are specified, and the overlapping of those standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement (which is

generally recognized to be also most costly) is intended and will be enforced, unless more detailed language written directly into Contract Documents clearly indicates that a less stringent requirement is acceptable.

2. Refer all uncertainties to ENGINEER for decision before proceeding.

### 1.03 REFERENCE STANDARDS

- A. Applicable standards of the construction industry are made a part of the Contract Documents by reference as if copied directly into the Contract Documents, or as if published copies were bound herewith. See Article 3.02 of the General Conditions for additional provisions regarding references.
- B. Standards referenced directly in the Contract Documents or by governing regulation, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
- C. Nonreference standards are hereby defined to have no particular applicability to the work except as a general measurement of whether the Work complies with standards recognized in the construction industry.
- D. Reference standards and codes listed in these specifications may include, but are not necessarily limited to, standards or codes published by the following agencies and organizations:

1. AA Aluminum Association  
1525 Wilson Boulevard, Arlington, VA 22209
2. AAMA American Architectural Manufacturer's Association  
1827 Walden Office Square Suite 550, Schaumburg, IL 60173-4268
3. AASHTO American Association of State Highway & Transportation Officials  
444 North Capitol Street NW Suite 249, Washington, DC 20001
4. ACI American Concrete Institute  
38800 Country Club Drive, Farmington Hills, MI 48331-3439
5. AI Asphalt Institute  
2696 Research Park Drive, Lexington, KY 40511-8480
6. AISC American Institute of Steel Construction  
One East Wacker Drive Suite 700, Chicago, IL 60601-1802
7. AISI American Iron and Steel Institute  
25 Massachusetts Avenue NW Suite 800, Washington, DC 20001
8. ANSI American National Standards Institute  
25 West 43rd Street, New York, NY 10036
9. APA American Plywood Association  
7011 South 19th, Tacoma, WA 98466-5333

10. API American Petroleum Institute  
1220 L Street NW, Washington, DC 20005-4070
11. ARI Air-Conditioning & Refrigeration Institute  
4100 North Fairfax Drive Suite 200, Arlington, VA 22203
12. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers  
1791 Tullie Circle NE, Atlanta, GA 30329
13. ASME American Society of Mechanical Engineers  
Two Park Avenue, New York, NY 10016-5990
14. ASSE American Society of Sanitary Engineering  
901 Canterbury Suite A, Westlake, OH 44145
15. ASTM ASTM International  
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
16. AWI Architectural Woodwork Institute  
46179 Westlake Drive Suite 120, Potomac Falls, VA 20165-5874
17. AWPA American Wood Protection Association  
P.O. Box 361784, Birmingham, AL 35236-1784
18. AWS American Welding Society  
8669 Doral Boulevard Suite 130, Doral, FL 33166
19. AWWA American Water Works Association  
6666 West Quincy Avenue, Denver, CO 80235
20. BHMA Builder's Hardware Manufacturers Association  
355 Lexington Avenue 15th floor, New York, NY 10017
21. BIA Brick Industry Association  
1850 Centennial Park Drive Suite 301, Reston, VA 20191
22. CRSI Concrete Reinforcing Steel Institute  
9333 North Plum Grove Road, Schaumburg, IL 60173
23. EJMA Expansion Joint Manufacturers Association  
25 North Broadway, Tarrytown, NY 10591
24. FM FM Global  
FM Global Corporate Offices, 270 Central Avenue, Johnston, RI 02919
25. FTI Facing Tile Institute  
Box 8880, Canton, OH 44711



26. GA Gypsum Association  
6525 Belcrest Road Suite 480, Hyattsville, MD 20782
27. GANA Glass Association of North America  
800 SW Jackson Street Suite 1500, Topeka, KS 66612-1200
28. ICC International Code Council  
500 New Jersey Avenue NW 6th Floor, Washington, DC 20001
29. IES Illuminating Engineering Society  
120 Wall Street, Floor 17, New York, NY 10005-4001
30. MIL Military Specifications  
Naval Publications and Forms Center  
5801 Tabor Avenue, Philadelphia, PA 19120
31. NAAMM National Association of Architectural Metal Manufacturers  
800 Roosevelt Road Building C Suite 312, Glen Ellyn, IL 60137
32. NCMA National Concrete Masonry Association  
13750 Sunrise Valley Drive, Herndon, VA 20171-4662
33. NECA NECA  
National Electrical Contractors Association  
3 Bethesda Metro Center Suite 1100, Bethesda, MD 20814
34. NEMA National Electrical Manufacturers Association  
1300 North 17th Street Suite 1752, Rosslyn, VA 22209
35. NFPA National Fire Protection Association  
1 Batterymarch Park, Quincy, MA 02169-7471
36. NIST National Institute of Standards and Technology  
(U.S. Department of Commerce), 100 Bureau Drive, Stop 1070  
Gaithersburg, MD 20899-1070
37. NRCA National Roofing Contractors Association  
10255 West Higgins Road Suite 600, Rosemont, IL 60018-5607
38. NSF National Sanitation Foundation International  
P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, MI 48113-0140
39. OSHA Occupational Safety & Health Administration  
200 Constitution Avenue NW, Washington, DC 20210
40. PCA Portland Cement Association  
5420 Old Orchard Road, Skokie, IL 60077
41. PCI Prestressed Concrete Institute  
200 West Adams Street Suite 2100, Chicago, IL 60606

- 42. SAE            Society of Automotive Engineers  
SAE World Headquarters  
400 Commonwealth Drive, Warrendale, PA 15096-0001
- 43. SDI           Steel Deck Institute  
P.O. Box 25, Fox River Grove, IL 60021
- 44. SDI           Steel Door Institute  
30200 Detroit Road, Westlake, OH 44145-1987
- 45. SIGMA        Sealed Insulating Glass Manufacturers Assoc.  
401 North Michigan Avenue Suite 2400, Chicago, IL 60611
- 46. SJI            Steel Joist Institute  
234 Cheves Street, Florence, SC 29501
- 47. SMACNA      Sheet Metal and Air Conditioning  
Contractor's National Association  
4201 Lafayette Center Drive, Chantilly, VA 20151-1219
- 48. SSPC         Society for Protective Coatings  
40 24th Street 6th Floor, Pittsburgh, PA 15222-4656
- 49. TCA           Tile Council of America  
100 Clemson Research Boulevard, Anderson, SC 29625
- 50. UL            Underwriters Laboratories  
333 Pfingston Road; Northbrook, IL 60062

#### 1.04 SUBMITTALS

- A. For OWNER's records, CONTRACTOR shall submit copies of permits, licenses, certifications, inspection reports, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

#### 1.05 DEFINITIONS

- A. Indicated:
  - 1. The term "indicated" is a cross-reference to details, notes, or schedules on the drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in the Contract Documents.
  - 2. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated", it is for the purpose of helping the reader locate cross-reference, and no limitation is intended except as specifically noted.
- B. Approve (or Words of Similar Nature):
  - 1. Where used in conjunction with ENGINEER's response to submittals, requests, applications, inquiries, reports, and claims by CONTRACTOR, the meaning of the term "approve" will be held to the limitation of ENGINEER's responsibilities and duties as specified in Paragraph 1.02.B.1. of the General Conditions.

2. In no case will "approval" by ENGINEER be interpreted as a release of CONTRACTOR from responsibility to fulfill requirements of the Contract Documents.
- C. Minimum Requirements:
1. Indicated requirements are for a specific minimum acceptable level of quality or quantity, as recognized in the industry.
  2. Actual work must comply with (or within specified tolerances) or exceed minimums.
  3. CONTRACTOR shall refer uncertainties to ENGINEER before proceeding.
- D. Abbreviations: Abbreviations, where not defined in the Contract Documents, will be interpreted to mean the normal construction industry terminology.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1–GENERAL

1.01 SUMMARY

- A. Work Includes:
  - 1. Quality Assurance–Control of Installation.
  - 2. Tolerances.
  - 3. Manufacturers' Field Services and Reports.

1.02 QUALITY ASSURANCE–CONTROL OF INSTALLATION

- A. CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- B. CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- D. CONTRACTOR shall 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. Work shall be performed by persons qualified to produce workmanship of specified quality.
- F. CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

- A. CONTRACTOR shall monitor tolerance control of installed products to produce acceptable work and shall not permit tolerances to accumulate.
- B. CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- C. CONTRACTOR shall adjust products to appropriate dimensions; position before securing products in place.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections or when requested by ENGINEER, CONTRACTOR shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship.

- B. CONTRACTOR shall submit qualifications of observer to ENGINEER 30 days in advance of required observations.
- C. CONTRACTOR shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. CONTRACTOR shall submit report in duplicate within 30 days of observation to ENGINEER for information.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 50 00

### TEMPORARY FACILITIES

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Temporary utilities.
  - 2. Temporary stairs and access.
  - 3. Temporary support facilities.
  - 4. Removal of temporary facilities.
- B. CONTRACTOR shall arrange for and provide temporary facilities as required for proper and expeditious prosecution of the Work.
- C. CONTRACTOR shall pay all costs, except as otherwise specified, until final acceptance of the Work unless OWNER makes arrangements for use of completed portions of the Work after substantial completion in accordance with the provisions of the General Conditions.
- D. CONTRACTOR shall make all temporary connections to utilities and services in locations acceptable to OWNER and local authorities having appropriate jurisdiction.
  - 1. Furnish all necessary labor and materials.
  - 2. Make all installations in a manner subject to the acceptance of such authorities and OWNER.
  - 3. Maintain such connections.
  - 4. Remove temporary installation and connection when no longer required.
  - 5. Restore services and sources of supply to proper operating conditions.

##### 1.02 TEMPORARY UTILITIES

- A. Temporary Toilets: CONTRACTOR shall provide and maintain sanitary temporary chemical toilets located where approved by OWNER and in sufficient number required for the work force employed by CONTRACTOR.
- B. Temporary Electrical Services:
  - 1. CONTRACTOR shall make all necessary arrangements, furnish, install, and maintain necessary temporary electrical services at the Site. CONTRACTOR shall remove all temporary services when Project is complete.
  - 2. All utility charges for installation of the temporary services shall be paid for by CONTRACTOR. All metering installation charges and all energy charges for electric current used for temporary lighting and power are to be paid by CONTRACTOR.
  - 3. No permanent electrical equipment or wiring shall be used without express written permission of OWNER. Such approval, if given, shall not affect guarantee period. If OWNER authorizes use of permanent service facilities, CONTRACTOR shall pay all metering costs until acceptance or occupancy (whichever occurs first) of building by OWNER.

- C. Weather Protection and Temporary Heat: CONTRACTOR shall provide weather protection to protect the Work from damage because of freezing, rain, snow, and other inclement weather.
- D. Temporary Water: CONTRACTOR shall supply its own water during construction. CONTRACTOR shall also provide its own piping, valves, and appurtenances for its requirements. Connection to the existing water system shall be coordinated with OWNER and shall meet all code requirements including disinfection and backflow prevention.
- E. Temporary Fire Protection: CONTRACTOR and Subcontractor(s) who maintain or provide an enclosed shed or trailer shall provide and maintain in operating order in each shed or trailer a minimum of one fire extinguisher. More extinguishers shall be provided as necessary. Fire extinguishers shall be minimum dry chemical, nonfreezing-type, UL rating 2A-30BC, with 10-pound capacity for Class A, B, and C fires.
- F. CONTRACTOR's and Subcontractor(s)' personnel shall refrain from smoking during excavation, laying pipe, backfilling, and other work at the Site which may involve potential contact with explosive vapors or gasoline products.

#### 1.03 TEMPORARY STAIRS AND ACCESS

- A. CONTRACTOR shall provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, chutes, and so on as required for proper execution of the Work. CONTRACTOR shall be responsible for providing its own scaffolds, hoists, etc.
- B. All such apparatus, equipment, and construction shall meet all requirements of OSHA, the labor laws, and other applicable State and local laws. Provide stairs with handrails. As soon as possible and where applicable, permanent stairs shall be installed.
- C. As soon as permanent stairs are created, provide temporary protective treads, handrails, and shaft protection.
- D. Provide barricades at hazardous locations, complete with signs, temporary general lighting, warning lights, and similar devices as required.

#### 1.04 TEMPORARY SUPPORT FACILITIES

- A. CONTRACTOR shall provide whatever facilities and services which may be needed to properly support primary construction process and meet compliance requirements and governing regulations.
- B. CONTRACTOR shall not use permanent facilities except as otherwise indicated, unless authorized by OWNER.

#### 1.05 REMOVAL OF TEMPORARY FACILITIES

- A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to final completion inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities and restore existing facilities used during construction to specified, or to original, condition.

- C. Minor temporary facilities which interfere with OWNER's operations shall be removed at the end of each Work period.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION



## SECTION 01 52 13

### FIELD OFFICES AND SHEDS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Materials, equipment, and furnishings.
  - 2. Construction.
  - 3. Environmental control.
  - 4. CONTRACTOR office and facilities.
  - 5. Storage areas and sheds.
  - 6. Preparation.
  - 7. Installation.
  - 8. Maintenance and cleaning.
  - 9. Removal.

#### PART 2–PRODUCTS

##### 2.01 MATERIALS, EQUIPMENT, AND FURNISHINGS

- A. Materials, equipment, and furnishings shall be serviceable, new or used, and adequate for required purpose.

##### 2.02 CONSTRUCTION

- A. Portable or mobile buildings or buildings shall be constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. CONTRACTOR shall provide structurally sound, secure, weathertight enclosures for office and storage spaces.
- C. Temperature transmission resistance of floors, walls, and ceilings shall be compatible with occupancy and storage requirements.
- D. Exterior materials shall be weather resistant.
- E. Interior materials in offices shall consist of sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- F. Lighting for offices shall be 50 footcandles minimum at desk top height, with exterior lighting at entrance doors.
- G. Provide appropriate type fire extinguisher at each office and each storage area.
- H. Interior materials in storage sheds shall be as required to provide specified conditions for storage of products.

## 2.03 ENVIRONMENTAL CONTROL

- A. Heating, cooling, and ventilating for offices shall consist of automatic equipment to maintain comfort conditions; 70°F heating and 78°F cooling.
- B. Heating and ventilation for storage spaces shall be as needed to maintain products in accordance with Contract Documents and to provide adequate lighting for maintenance and observation of products.

## 2.04 CONTRACTOR OFFICE AND FACILITIES

- A. CONTRACTOR shall provide facilities to meet CONTRACTOR's needs and to provide space for Project meetings.
- B. Provide telephone as required for CONTRACTOR's needs.
- C. Provide furnishings in meeting area. As a minimum, provide conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.

## 2.05 STORAGE AREAS AND SHEDS

- A. Provide storage areas and sheds of size to meet storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for observation of products to meet requirements of Section 01 60 00—Materials and Equipment.

## PART 3—EXECUTION

### 3.01 PREPARATION

- A. CONTRACTOR shall fill and grade sites for temporary structures to provide drainage away from buildings.

### 3.02 INSTALLATION

- A. CONTRACTOR shall install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed or as agreed upon by ENGINEER.
- B. Provide two hard surfaced parking spaces for use by ENGINEER, connected to office by hard surfaced walk.

### 3.03 MAINTENANCE AND CLEANING

- A. CONTRACTOR shall maintain approach walks free of mud, water, and snow.

### 3.04 REMOVAL

- A. Upon final acceptance and completion of the Work, CONTRACTOR shall remove field offices, foundations, utility services, and debris and shall restore areas.

END OF SECTION

Section 01 52 13-2

1020.124/9063

SECTION 01 57 00

TEMPORARY CONTROLS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Dust Control.
  - 2. Water, Erosion, and Sediment Control.
  - 3. Noise Control.
  - 4. Traffic Control.
  - 5. Site Security.
  - 6. Daily Cleanup.

PART 2—PRODUCTS

NOT APPLICABLE

PART 3—EXECUTION

3.01 DUST CONTROL

- A. CONTRACTOR shall execute the Work by methods to minimize raising dust from construction operations.
- B. CONTRACTOR shall provide positive means to prevent airborne dust from dispersing into atmosphere.
- C. CONTRACTOR shall provide partitions, enclosures, etc., within buildings as necessary to confine dust and protect adjacent areas.

3.02 WATER, EROSION, AND SEDIMENT CONTROL

- A. CONTRACTOR shall grade site to drain and shall maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. CONTRACTOR shall protect Site from puddling or running water.
- C. CONTRACTOR shall provide erosion control measures as necessary to control discharge of sediment laden water to surface waters and wetlands.
- D. Except as provided for in the document, overland discharge of water from dewatering operations shall not be allowed. Depending on water quality, such water shall either be piped directly to the surface water or shall be directed to sedimentation basins or other such structures or features prior to discharge to surface waters so as not to cause damage to existing ground and improvements, erosion, or deposition in the discharge area.

- E. CONTRACTOR shall use jute or synthetic netting, silt fences, straw bales, dikes, channels, and other applicable measures to prevent erosion of soils disturbed by its construction operation.
- F. Restoration of the Site shall proceed concurrently with the construction operation. See Drawings and Specifications for erosion control measures in addition to that which may be required above.
- G. Erosion control measures shall comply with DNR Conservation Practice Standards-Construction Site Erosion and Sediment Controls.

### 3.03 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

### 3.04 TRAFFIC CONTROL

- A. CONTRACTOR shall be responsible for providing all signs, barricades, flagmen, and other traffic control devices in the construction zone.
- B. All traffic control measures shall meet the requirements of Part 6 of the Manual on Uniform Traffic Control Devices of the State of Wisconsin.
- C. Do not close or obstruct roadways without approval of OWNER.
- D. Conduct operations with minimum interference to roadways.
- E. Maintain two-way traffic on streets at all times.

### 3.05 SITE SECURITY

- A. CONTRACTOR shall have the sole responsibility of safeguarding the Site perimeter to prevent unauthorized entry to the Site throughout the duration of the Project. CONTRACTOR shall at all times provide such permanent and temporary fencing or barricades or other measures as may be necessary to restrict unauthorized entry to its construction area including construction in public rights-of-way or easements. Site security measures shall include safeguards against attractive nuisance hazards as a result of construction activity.
- B. CONTRACTOR shall at all times be responsible for the security of the Work including materials and equipment. OWNER will not take any responsibility for missing or damaged equipment, tools, or personal belongings. CONTRACTOR shall have the sole responsibility of safeguarding the Work and the Site throughout the duration of the Project.

### 3.06 DAILY CLEANUP

- A. CONTRACTOR shall clean up the Site and remove all rubbish on a daily basis.
- B. CONTRACTOR shall clean up public streets and highways and remove any dirt, mud, or other materials due to project traffic on daily basis, and shall comply with all local and state ordinances and permit requirements.

END OF SECTION

## SECTION 01 60 00

### MATERIALS AND EQUIPMENT

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for the delivery, handling, storage and protection of all material and equipment required to complete the Work as specified herein.
- B. Related Sections and Divisions: Specific requirements for the handling and storage of material and equipment are described in other sections of these Specifications.

##### 1.02 PRODUCTS

- A. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.
- B. CONTRACTOR shall not use materials and equipment removed from existing construction, except as specifically required, or allowed, by the Contract Documents.
- C. When any construction deviations from the Drawings and/or Specifications necessary to accommodate equipment supplied by CONTRACTOR, result in additional costs to CONTRACTOR or other contractors, such additional costs shall be borne by CONTRACTOR. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.
- D. Each major component of equipment shall bear a nameplate giving the name and address of the manufacturer and the catalogue number or designation.

##### 1.03 TRANSPORTATION AND HANDLING

- A. Materials, products and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.
- B. CONTRACTOR shall not overload any portion of the structure in the transporting or storage of materials.
- C. CONTRACTOR shall not damage other construction by careless transportation, handling, spillage, staining or impact of materials.
- D. CONTRACTOR shall provide equipment and personnel to handle products, including those provided by OWNER, by methods to prevent soiling and damage.
- E. CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.
- F. CONTRACTOR shall handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

#### 1.04 DELIVERY AND RECEIVING

- A. CONTRACTOR shall arrange deliveries of products in accordance with the Progress Schedule, allowing time for observation prior to installation.
- B. CONTRACTOR shall coordinate deliveries to avoid conflict with the Work and conditions at the Site; work activities of other contractors or OWNER; limitations on storage space; availability of personnel and handling equipment and OWNER's use of premises.
- C. CONTRACTOR shall deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. CONTRACTOR shall clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- E. Immediately on delivery, CONTRACTOR shall inspect shipment to review that:
  - 1. Product complies with requirements of Contract Documents and reviewed submittals.
  - 2. Quantities are correct.
  - 3. Accessories and installation hardware are correct.
  - 4. Containers and packages are intact and labels legible.
  - 5. Products are protected and undamaged.

#### 1.05 STORAGE AND PROTECTION

- A. General:
  - 1. CONTRACTOR shall store products, immediately on delivery, in accordance with manufacturer's instructions, with all seals and labels intact and legible.
  - 2. Any additional off-site space required shall be arranged by CONTRACTOR.
  - 3. CONTRACTOR shall allocate the available storage areas and coordinate their use by the trades on the job.
  - 4. CONTRACTOR shall arrange storage in a manner to provide access for maintenance of stored items and for observation.
- B. In enclosed storage, CONTRACTOR shall:
  - 1. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.
  - 2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
  - 3. Provide ventilation for sensitive products as required by manufacturer's instructions.
  - 4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
  - 5. Store solid materials such as insulation, tile, mechanical and electrical equipment, fittings, and fixtures under shelter, in original packages, away from dampness and other hazards.
  - 6. Store liquid materials away from fire or intense heat and protect from freezing.
- C. At exterior storage, CONTRACTOR shall:
  - 1. Store unit materials such as concrete block, brick, steel, pipe, conduit, door frames, and lumber off ground, out of reach of dirt, water, mud and splashing.
  - 2. Store tools or equipment that carry dirt outside.
  - 3. Store large equipment so as not to damage the Work or present a fire hazard.
  - 4. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet material and provide ventilation to avoid condensation.

5. Completely cover and protect any equipment or material which is prime coated or finish painted with secured plastic or cloth tarps. Store out of reach of dirt, water, mud and splashing.
6. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
7. Provide surface drainage to prevent erosion and ponding of water.
8. Prevent mixing of refuse or chemically injurious materials or liquids.
9. Cover aggregates such as sand and gravel in cold wet weather.
10. Remove all traces of piled bulk materials at completion of work and return site to original or indicated condition.

#### 1.06 MAINTENANCE OF STORAGE

- A. CONTRACTOR shall periodically inspect stored products on a scheduled basis.
- B. CONTRACTOR shall verify that storage facilities comply with manufacturer's product storage requirements, and verify that manufacturer required environmental conditions are maintained continually.
- C. CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.
- D. CONTRACTOR shall perform scheduled maintenance of equipment in storage as recommended by the manufacturer. A record of the maintenance shall be kept and turned over to ENGINEER when the equipment is installed.

#### 1.07 INSTALLATION REQUIREMENTS

- A. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respective manufacturers, unless otherwise specified.
- B. After installation, CONTRACTOR shall protect all materials and equipment against weather, dust, moisture, and mechanical damage.
- C. CONTRACTOR shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until completion and final acceptance of the Work by OWNER. Damaged material and equipment shall be immediately removed from the Site.

#### 1.08 EQUIPMENT WARRANTIES

- A. Warranties shall be nonprorated, include all parts and labor, and be in written form. Warranties shall specifically exclude buyer's indemnification language. Warranty language shall not eliminate manufacturer's responsibility for sizing of the equipment. During warranty period, manufacturer shall be responsible for any travel expenses, outside contractor fees, and rental equipment fees associated with providing warranty service. Manufacturer shall pay expenses incurred for repairs and parts replacement not made by manufacturer if manufacturer's response is not within 72 hours of notification by OWNER. Warranty language shall be provided with the shop drawings.

## 1.09 CONCRETE EQUIPMENT BASE

- A. Cast-in-place concrete equipment bases shall be provided for all new and relocated equipment including electrical control panels, motor control centers, switchgear, etc. Concrete equipment bases shall be provided by CONTRACTOR except where specifically noted to be provided by others. Bases shall be 3 1/2-inch minimum height and shall be a minimum of 3 inches larger than equipment being supported. Grouting of equipment bases shall be as recommended by equipment manufacturer.
- B. Concrete and grout shall meet applicable sections of the specifications.
- C. Provide all anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete for support of equipment.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION



## SECTION 01 73 29

### CUTTING, PATCHING, AND ALTERATIONS

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for all cutting, fitting, patching, and other alterations required to complete the Work as specified herein or to:
  - 1. Make its several parts fit together properly.
  - 2. Uncover portions of the Work to install improperly sequenced Work.
  - 3. Remove and replace defective Work.
  - 4. Remove and replace Work not conforming to requirements of the Contract Documents.
  - 5. Remove samples of installed Work as specified for testing.
  - 6. Provide penetrations of surfaces for installation of piping and electrical conduit.
  - 7. Rehabilitate or renovate existing spaces.

##### 1.02 REFERENCES

- A. ANSI A10 Safety Requirements for Construction and Demolition.

##### 1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform all cutting, patching, and alterations in strict accordance with pertinent requirements of these Specifications.
- B. Except as modified by governing codes, CONTRACTOR shall comply with the applicable provision and recommendations of ANSI A10.

##### 1.04 SUBMITTALS

- A. CONTRACTOR shall submit a written request to OWNER well in advance of executing any cutting or alteration which affects the following:
  - 1. Work of OWNER or any separate contractor.
  - 2. Structural value or integrity of any element of the Project.
  - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
  - 4. Efficiency, operational life, maintenance, or safety of operational elements.
  - 5. Visual qualities of sight-exposed elements.
- B. The request shall include:
  - 1. Description of affected work.
  - 2. The necessity for cutting, patching, or alteration.
  - 3. Effect on work of OWNER, any separate contractor, or on the structural or weather-proof integrity of the Project.
  - 4. Description of proposed work to include:
    - a. Scope of cutting, patching, or alteration.
    - b. Trades who will execute the work.
    - c. Products proposed to be used.
    - d. Extent of refinishing to be done.

5. Alternatives to cutting and patching.
  6. Written permission of any separate contractor whose work will be affected.
- C. Submit written notice to OWNER designating the date and the time the Work will be uncovered or executed.

#### 1.05 SCHEDULING AND COORDINATION

- A. All work under this section shall be coordinated with OWNER's work forces and those of other contractors and shall be accomplished at times acceptable to OWNER.
- B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service to the existing building, notify ENGINEER and OWNER 72 hours in advance and obtain OWNER's approval before proceeding with this phase of the work. Temporary facilities, if required, shall be in place prior to disruption of service.

### PART 2-PRODUCTS

#### 2.01 NEW MATERIALS

- A. For replacement of work removed, CONTRACTOR shall use materials which comply with the pertinent sections of these Specifications.
- B. All new materials for patching and extending work shall match existing products and work.
- C. CONTRACTOR shall determine type and quality of existing products by inspection and any necessary testing and workmanship by use of existing as the standard.

#### 2.02 SALVAGEABLE MATERIAL

- A. Materials or items designated to be reinstalled or to become the property of OWNER shall be as specified or as shown on the Drawings.
- B. CONTRACTOR shall remove such items with care under the supervision of the trade responsible for reinstallation.
- C. CONTRACTOR shall store these materials (off-site if necessary) and protect from damage until they are incorporated into the new work.
- D. Items which are not to be reinstalled but are to become the property of OWNER shall be removed by CONTRACTOR with care, cleaned, and stored in a location at the Site to be approved by OWNER.
- E. Materials or items damaged in its removal shall be replaced by CONTRACTOR with similar new material at no additional cost to OWNER.
- F. Where existing equipment or fixtures are indicated to be reused, CONTRACTOR shall repair such equipment and refinish as specified elsewhere.

## 2.03 UNSALVAGEABLE MATERIALS

- A. Materials or items demolished and not designated to become the property of OWNER or not designated to be reinstalled shall become the property of CONTRACTOR and shall be removed from the site and legally and properly disposed of by CONTRACTOR.
- B. Materials shall be removed by CONTRACTOR in a manner that will avoid damage to materials or equipment to remain.

## PART 3—EXECUTION

### 3.01 INSPECTION

- A. CONTRACTOR shall inspect existing conditions including elements subject to movement or damage during cutting, patching, and other alterations.
- B. After uncovering the work, CONTRACTOR shall inspect conditions affecting installation of new products or performance of new work.
- C. CONTRACTOR shall report unsatisfactory or questionable conditions to ENGINEER in writing.
- D. CONTRACTOR shall not proceed with work until unsatisfactory or questionable conditions are resolved.
- E. Beginning of cutting, patching, and alterations work means acceptance of existing conditions by CONTRACTOR.

### 3.02 PREPARATION AND PROTECTION

- A. CONTRACTOR shall provide temporary bracing, shoring, needling, and support of the structure during alterations work as necessary to prevent collapse, settling, or deflection and to protect persons and property from injury or damage.
- B. Temporary supports must adequately carry all existing and imposed load.
- C. CONTRACTOR shall provide and maintain temporary protection of surface finishes, equipment, and adjacent work designated to remain where demolition, removal, and new work is being done, connections are being made, materials are being handled, or equipment is being removed.
- D. CONTRACTOR shall provide temporary partitions or barriers to contain all dust, dirt, and debris from entering into finished areas or areas where OWNER is operating, storing, or manufacturing products.
- E. CONTRACTOR shall provide adequate fire protection in accordance with local Fire Department requirements.
- F. CONTRACTOR shall provide waterproofing, weather protection, heat, and other facilities for that portion of the work which may be exposed by cutting and patching, demolition, or other alterations.

- G. CONTRACTOR shall cut, move, or remove items as necessary for access to alterations and renovations work and replace and restore at completion of work.
- H. CONTRACTOR shall prepare surfaces and remove surface finishes to provide for proper installation of new work and new finishes.
- I. CONTRACTOR shall be responsible for any damage to the existing structure or its contents directly or indirectly by its crews or those of its subcontractors.

### 3.03 PERFORMANCE

- A. CONTRACTOR shall accomplish all work of cutting, removal, demolition, patching, or other alterations using only persons skilled in the appropriate trade.
- B. CONTRACTOR shall execute the work in a careful and orderly manner with the least possible disturbance to the public and to the occupants of the building.
- C. CONTRACTOR shall execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- D. CONTRACTOR shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- E. CONTRACTOR shall fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- F. CONTRACTOR shall thoroughly clean and prepare all surfaces to receive new finish or covering to completely remove all dirt, dust, grease, oil, paint, loose materials, and soil.
- G. CONTRACTOR shall refinish entire surface as necessary to provide an even finish to match adjacent finishes:
  - 1. For continuous surfaces, refinish to nearest intersection.
  - 2. For an assembly, refinish entire unit.

### 3.04 DEMOLITION, CUTTING, AND REMOVAL

- A. Cutting and removal of construction shall be performed by CONTRACTOR so as not to cut or remove more than is necessary and so as not to damage adjacent work.
- B. CONTRACTOR shall cut out embedded anchorages and attachment items as required to properly provide for patching and repair of the respective finishes.
- C. CONTRACTOR shall not cut structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
- D. CONTRACTOR shall not cut operational elements and safety components in a manner resulting in decreased performance, shortened useful life, or increased maintenance.
- E. CONTRACTOR shall not cut work exposed to view (exterior or interior) in a manner resulting in noticeable reduction of visual qualities as determined by OWNER.

- F. Construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of careless cutting or demolition and is unsuitable for use intended shall be removed and replaced at no additional cost to OWNER.
- G. CONTRACTOR shall clean demolished areas and remove debris, waste, and rubbish from the building at the conclusion of each day's work.
- H. CONTRACTOR shall not let piled waste material endanger the structure.

### 3.05 PATCHING, EXTENDING, AND MATCHING

- A. Patching work shall conform to the standards of the Specifications where applicable, and where not specified, work shall conform to the highest standards of the applicable trade.
- B. CONTRACTOR shall patch construction to match adjacent work unless noted otherwise.
- C. Patching or restoration shall be carried to natural breaks (e.g., corners) wherever possible.
- D. CONTRACTOR shall provide adequate support to substrate for patching finishes.
- E. At locations in existing areas where partitions are removed, CONTRACTOR shall patch floors, walls, and ceiling with finish material to match adjacent surfaces.
- F. Transitions:
  - 1. Where new work abuts or finishes flush with existing work, CONTRACTOR shall make the transition as smooth as possible.
  - 2. Patched work shall match adjacent work in texture and appearance so as to make the patch or transition invisible to the eye at a distance of 3 feet.
  - 3. Where masonry, tile, plaster, metal, or other finished surface is cut in such a way that a smooth transition is not possible, CONTRACTOR shall terminate the existing surface in a neat fashion along a straight line at a natural line of division and provide trim appropriate to the finished surface.
  - 4. Where two or more spaces are indicated to become one space, CONTRACTOR shall rework floors and ceilings so that horizontal planes are without breaks, steps, or bulkheads, unless shown otherwise.
  - 5. In case of extreme level changes (3 inches or more), review condition with ENGINEER prior to making transition.
  - 6. CONTRACTOR shall restore existing work that is damaged during patching operations to a condition equal to its construction at the time of the start of work.

### 3.06 UNANTICIPATED MECHANICAL AND ELECTRICAL WORK EXPOSED

- A. Where unanticipated mechanical piping or electrical conduit is exposed during removal of partitions or walls, removal or rerouting shall be accomplished by CONTRACTOR as applicable.
  - 1. Rerouted piping shall be located and shall be connected to maintain all functions in proper operations.
  - 2. Abandoned piping may be left in place where it is buried in floors or walls, providing that it is completely disconnected from its source.
  - 3. There shall be no "dead end" gas, water, sewer, or vent piping existing in the completed work.

4. Unless otherwise shown, abandoned piping, ductwork, conduit, or other mechanical or electrical items in chases, vertical enclosures, or concealed above ceilings shall be completely removed.
- B. Removals, capping, or otherwise terminating services which are abandoned shall be accomplished without additional cost to OWNER.
  - C. Relocation of services resulting from unanticipated conflicts of new and existing work in concealed spaces shall be paid for in accordance with the General Conditions.

END OF SECTION

SECTION 01 77 00  
CONTRACT CLOSEOUT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Closeout procedures.
  - 2. Final cleaning.
  - 3. Adjusting.
  - 4. Project record documents.
  - 5. Warranties.

1.02 CLOSEOUT PROCEDURES

- A. CONTRACTOR shall provide submittals to ENGINEER that are required by governing or other authorities.
- B. CONTRACTOR shall comply with General Conditions and Supplementary Conditions and complete the following before requesting ENGINEER's observation of the Work or designated portion thereof for substantial completion.
  - 1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of Work, enabling OWNER's unrestricted occupancy and use.
  - 2. Submit record documentation, maintenance manuals, tools, spare parts, keys, and similar operational items.
  - 3. Submit consent of surety (if surety required in Contract).
  - 4. Complete final cleaning, touch-up work of marred surfaces, and remove temporary facilities and tools.

1.03 FINAL CLEANING

- A. It is CONTRACTOR's responsibility to completely clean up the inside and outside of all buildings and the construction site at the completion of the Work.
- B. CONTRACTOR shall clean areas of the building in which painting and finishing work is to be performed just prior to the start of this work and maintain these areas in satisfactory condition for painting and finishing. This cleaning includes:
  - 1. Removal of trash and rubbish from these areas.
  - 2. Broom cleaning of floors.
  - 3. Removal of any plaster, mortar, dust, and other extraneous materials from finish surfaces, including but not limited to exposed structural steel, miscellaneous metal, masonry, concrete, mechanical equipment, piping, and electrical equipment.
- C. In addition to the cleaning specified above and the more specific cleaning that may be required in various technical sections of the Specifications, CONTRACTOR shall prepare the Project for occupancy by a thorough cleaning throughout, which shall include the following:

1. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
3. Replace filters of operating equipment.
4. Clean debris from roofs, gutters, downspouts, and drainage systems.
5. Clean site; sweep paved areas, rake clean landscaped surfaces.
6. Remove waste and surplus materials, rubbish, and construction facilities from the Site.

#### 1.04 ADJUSTING

- A. CONTRACTOR shall adjust operating products and equipment to provide smooth and unhindered operation.

#### 1.05 PROJECT RECORD DOCUMENTS

- A. CONTRACTOR shall maintain on Site one set of the following record documents to record actual revisions to the Work:
  1. Drawings.
  2. Specifications.
  3. Addenda.
  4. Change orders and other modifications to the Contract.
  5. Reviewed shop drawings, product data, and samples.
  6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. CONTRACTOR shall make entries that are complete and accurate, enabling future reference by OWNER.
- C. CONTRACTOR shall store record documents separate from documents used for construction.
- D. CONTRACTOR shall record information concurrent with construction progress.
- E. Specifications: CONTRACTOR shall legibly mark and record at each Product 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.
- F. Record Drawings: CONTRACTOR shall legibly mark each item to record actual construction including:
  1. Measured depths of foundations in relation to finish floor datum.
  2. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
  3. Measured locations of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of the work.
  4. Field changes of dimension and detail.
  5. Details not on original Contract drawings.



## 1.06 WARRANTIES

- A. CONTRACTOR shall provide warranties beyond project one-year warranty as required by technical sections and as follows.
- B. Submit warranty information as follows:
  - 1. Provide notarized copies.
  - 2. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers, and provide Table of Contents and assemble in three-ring binder with durable cover.
  - 3. Submit with request for certificate of Substantial Completion.
  - 4. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance listing date of acceptance as start of warranty period.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 91 00

STARTING OF SYSTEMS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. General.
  - 2. Equipment and system installation.
  - 3. Starting equipment and systems.
  - 4. Demonstration, instructions, and operator training.
  - 5. Start-up and testing.
  - 6. Equipment systems requiring certification of proper installation.
- B. CONTRACTOR shall perform the Work described in the following subsections.

1.02 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 because of equipment malfunction or other problem, such time shall be at the expense of CONTRACTOR, with no change in Contract Price.
- B. "Days" specified shall consist of 8-hour days on-site, excluding travel time.
- C. 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 ENGINEER and OWNER. Such schedule shall be arranged with the appropriate subcontractors, manufacturers, and suppliers with sufficient time to allow their compliance with the service requirements.
- D. CONTRACTOR shall manage equipment checkout such that checkout has been completed and deficiencies addressed prior to demonstration and training. Scheduling training prior to checkout may result in cancellation when checkout cannot be completed prior to training.

1.03 EQUIPMENT AND SYSTEM INSTALLATION

- A. Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems for as many days as may be necessary to provide proper installation and to resolve assembly or installation problems at the site that are attributable to, or associated with, the equipment furnished. This requirement applies to manufacturers for all equipment furnished, whether or not specifically set forth in the Specifications.
- B. Where a manufacturer's certificate is called for in this Specification Section, 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, that the proper electrical and mechanical connections have been made, and that any other manufacturer requirements have been met. This certification shall be provided to

ENGINEER and OWNER prior to the start-up. This certificate is in addition to the manufacturer's standard startup reports, checklists, and other pertinent information.

- 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 start-up.
- D. Manufacturer shall demonstrate, using laser alignment equipment, if appropriate, that the installed equipment has been aligned properly. Final acceptance of equipment will not be granted until manufacturer has demonstrated to ENGINEER that acceptable alignment to tolerances have been achieved. For pumps with motors 7.5 hp and larger, the acceptable shaft alignment tolerances shall be as recommended in the pump manufacturer's written instructions and shall include parallel offset and angular gap measurements.

#### 1.04 STARTING EQUIPMENT AND SYSTEMS

- A. Where field testing and start-up services are called for in the Specifications, or when technical assistance is necessary as a result of any malfunction of the equipment or system furnished, the manufacturer's representative shall provide such services.
- B. 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 OWNER for full-time operation.
- C. Coordinate schedule for start-up of various equipment and systems. Coordination includes, but is not limited to, communication with subcontractors, suppliers, OWNER, and ENGINEER. CONTRACTOR shall confirm that all necessary work is complete and that the equipment and systems can be operated in conjunction with all associated processes.
- D. Notify ENGINEER and OWNER a minimum of 7 days prior to start-up of each item using the attached Equipment Startup and O&M Training Scheduling form. CONTRACTOR shall submit form to ENGINEER.
- E. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.
- F. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- G. Verify wiring and support components for equipment are complete and tested.
- H. Execute start-up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.
- I. 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. Authorized representative shall provide approval for starting of systems in writing where specified.

- J. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report. In addition, CONTRACTOR shall submit a fully executed Certificate of Proper Installation form if required in Paragraph 3.01 of this section.

#### 1.05 DEMONSTRATION, INSTRUCTIONS, AND OPERATOR TRAINING

- A. For all mechanical equipment and systems and where called for in the Specifications, provide a qualified technical representative to provide detailed instructions to OWNER's personnel for operation and maintenance of equipment and associated instrumentation. Training services shall include pre-start-up classroom instruction and start-up on-site instruction, as stated in the Specifications.
- B. Refer to the Specifications for additional training requirements.
- C. CONTRACTOR shall coordinate the pre-start-up training periods with OWNER's operating personnel and manufacturers' representatives.
  - 1. Schedule training dates and times with OWNER, that are acceptable to the OWNER, using equipment, startup, and O&M training form. Normal hours available for training are between 7:30 A.M. to 3 P.M., Monday through Friday, except for holidays.
  - 2. Submit outline and presentation to ENGINEER at least 7 days in advance of training.
  - 3. Provide name, contact information, and brief synopsis of qualifications of the trainer.
  - 4. If materials above are not provided at least 7 days in advance, training may be canceled.
  - 5. Failure of supplier's or manufacturer's representative to appear for scheduled training, failure to notify OWNER 24 hours in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to OWNER for time lost by OWNER's personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hour for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late, up to 1 hour, after 1 hour, training will be rescheduled. CONTRACTOR shall reimburse OWNER via a change order.
  - 6. During the training, instructor will dedicate its time solely to training and not start-up services.
  - 7. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.
  - 8. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment.
  - 9. Prepare and insert additional data in operation and maintenance manuals when need for additional data becomes apparent during instruction.
  - 10. OWNER may videotape the training for future internal use. Provide to OWNER paper and electronic copies of any media used as part of training.
  - 11. Provide training handouts for each of OWNER's personnel present.
- D. CONTRACTOR shall provide attached Certificate of Operator Training cosigned by OWNER and supplier's representative verifying training was accomplished to satisfaction of all parties.
- E. Operation and maintenance manual submitted in accordance with Section 01 33 00-Submittals shall be provided prior to operator training.

- F. For equipment or systems requiring seasonal operation, perform demonstration for dormant season at start of dormant season.
- G. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to OWNER's satisfaction.
- H. Where items of equipment are placed into service at different times or sequence, manufacturer's services for start-up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.

#### 1.06 START-UP AND TESTING

- A. Prior to acceptance of any portion of the Work, start-up and testing of all equipment and testing of all materials furnished on the Project by CONTRACTOR shall have been conducted in the presence of representatives of CONTRACTOR, OWNER, and ENGINEER and also manufacturer if requested by OWNER or ENGINEER.
- B. CONTRACTOR shall provide whatever temporary installations and conditions are necessary in order to perform start-up and testing operations on all equipment and materials furnished under the Contract. Temporary connections and equipment necessary during start-up and testing operations shall include, but not be limited to, temporary piping and electrical power and control equipment and devices, temporary connection from various parts of the systems and any other labor, materials, fuel, devices, or items that may be required for start-up and testing operations. Temporary conditions shall include filling with water, if necessary, to check equipment and materials.
- C. All temporary installations and conditions shall be removed by CONTRACTOR upon completion of start-up and testing.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

#### 3.01 EQUIPMENT SYSTEMS REQUIRING CERTIFICATION OF PROPER INSTALLATION

- A. All space and process related heating, cooling, and ventilation equipment and systems specified in Division 23.
- B. Section 26 09 00-Controls and Instrumentation (PART 3-EXECUTION).
- C. Section 26 13 29-Low-Voltage Metal-Enclosed Drawout Switchgear.
- D. Section 26 32 13-Standby Power System.
- E. Section 33 32 00-Submersible Pumping Station.
- F. Section 40 05 00-Piping and Appurtenances.

END OF SECTION

TS No. \_\_\_\_\_

EQUIPMENT START-UP AND O&M TRAINING SCHEDULING FORM  
STRAND ASSOCIATES, INC.®

PROJECT \_\_\_\_\_ CLIENT \_\_\_\_\_

CONTRACT \_\_\_\_\_

CONTRACTOR \_\_\_\_\_ Date: \_\_\_\_\_

The following equipment is scheduled for start-up on \_\_\_\_\_

EQUIPMENT NAME: \_\_\_\_\_ SPECIFICATION SECTION: \_\_\_\_\_

MANUFACTURER: \_\_\_\_\_ MINIMUM HOURS OF TRAINING: \_\_\_\_\_

DATE O&M MANUALS SUBMITTED: \_\_\_\_\_

Specification Section 01 91 00 requires that start-up and operation and training be conducted by a qualified manufacturer's representative prior to placing equipment in operation. Review Specification Sections 01 33 00 and 01 45 00 and the individual equipment sections for start-up and training requirements. OWNER may find it necessary to propose alternate dates for training based on conflicts with other training and staff availability. The Operation and Maintenance Manuals must be submitted prior to training.

After the equipment or system has been properly installed and is functioning correctly, submit a written report in accordance with Specification Section 01 45 00.

Submit the completed form to ENGINEER and OWNER at least 7 days prior to start-up and training.

Proposed Training Date: \_\_\_\_\_ Time of Training: \_\_\_\_\_

Factory-trained representative giving training:

Name(s): \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_

CERTIFICATE OF PROPER INSTALLATION

Project \_\_\_\_\_

Equipment \_\_\_\_\_

Specification Section \_\_\_\_\_

Contract \_\_\_\_\_

I hereby certify the equipment supplier/manufacture 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 ENGINEER prior to OWNER training.

CERTIFICATE OF OPERATOR TRAINING

Project \_\_\_\_\_

Equipment \_\_\_\_\_

Specification Section \_\_\_\_\_

Contract \_\_\_\_\_

I hereby certify the equipment supplier/manufacture 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 state that my operating personnel received instruction for start-up, operation, and maintenance of this equipment.

Signature \_\_\_\_\_ Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Title \_\_\_\_\_

END SECTION



## SECTION 02 41 00

### DEMOLITION

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: All demolition, removal, and salvage work as shown on the drawings or specified herein to include, but not necessarily limited to the following:
  - 1. Masonry Control Building.
  - 2. Electrical equipment and electric utility service.
  - 3. Pumps, piping, and appurtenances.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. CONTRACTOR shall submit permits and notices, if required, authorizing building demolition.

##### 1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform demolition, removal, and salvage in conformity with applicable federal, state, and local safety practices and code requirements.
- B. CONTRACTOR shall contact all public utilities and shall shut off, cut and cap all utility services in accordance with utility requirements, codes, rules and regulations.
- C. Obtain and pay for all necessary permits, licenses and certificates required.

##### 1.04 SEQUENCE

- A. No demolition, removal, or salvage work shall commence until approval to proceed has been granted by OWNER. Such work shall be completed in accordance with the construction sequence included in Division 01 of these specifications and in accordance with the construction phases of this project and work to be done by other contractors.
- B. OWNER has completed an asbestos inspection at each existing facility where work is required to be completed by CONTRACTOR. Work under this item shall include the removal and proper disposal (including proper documentation) of asbestos found to be present with the findings provided in the report from A&A Environmental Services dated September 11, 2017 (see report included with specifications). According to the A&A report, asbestos was found to be present in three electrical boxes (bakelite) and in the white caulking around the entry door. CONTRACTOR will be responsible to fill out the appropriate paperwork (WDNR form 4500-113). A&A has offered to remove and dispose of the asbestos for \$2,235 in the proposal included with their report.

## PART 2-PRODUCTS

### 2.01 GENERAL

- A. Compacted fill shall meet the requirements of Section 31 23 00-Excavation, Fill, Backfill and Grading.
- B. Pipe fittings and materials shall meet the requirements of Section 40 05 00-Piping and Appurtenances.

## PART 3-EXECUTION

### 3.01 BREAKING DOWN AND REMOVING STRUCTURES

- A. General:
  - 1. All existing structures, with all attached parts and connections, shown on the drawings or specified to be removed or that interfere with the new construction, shall be entirely removed within the limits shown or specified, unless otherwise provided.
  - 2. When a portion of any existing structure is to be retained, CONTRACTOR shall take care during construction operations so as not to impair the value of the retained portion.
    - a. Complete all operations necessary for the removal of any existing structure which might endanger the new construction prior to the construction of the new work.
    - b. Do not use any equipment or devices which might damage structures, facilities, or property which are to be preserved and retained.
  - 3. When existing reinforcing is exposed at the surface of removal areas, CONTRACTOR shall burn back the reinforcing bars 2 inches and patch with nonshrink grout, unless noted otherwise.
- B. Pavement and Similar Structures:
  - 1. Where portions of the existing structure are to be left in the surface of the finished work, CONTRACTOR shall remove the structure to an existing joint, or saw and chip the structure to a true line.
  - 2. Sufficient removal shall be made to provide for proper grades and connections in the new work.
- C. Walls and Similar Masonry Structures: Remove existing construction as required to clear new construction.

### 3.02 ABANDONING AND REMOVING UTILITIES AND UNDERGROUND PROCESS PIPING

- A. CONTRACTOR shall be responsible for the turning off or unhooking of all utilities and process piping before starting the demolition work. Remove all utility lines, including electrical services and process piping that are shown or specified to be removed. Remove utility lines that are to be abandoned as needed to clear new construction.
- B. The ends of utility lines and process piping shown or specified to be abandoned that are exposed by excavation shall be plugged with concrete to prevent soil infiltration into the pipes.

### 3.03 EQUIPMENT

- A. CONTRACTOR shall remove all equipment specified herein or indicated.
- B. CONTRACTOR shall remove associated exposed conduit, power wiring, controls, switches, instrumentation, control wiring, control boxes, appurtenances, and their supports serving equipment to be removed. Electrical items shall be removed to their junction with motor control center, control panel, or their junction with conduit serving other equipment that is to remain.
- C. CONTRACTOR shall remove all piping and appurtenances and their supports serving equipment indicated to be removed. Piping shall be removed to its junction with the main service header serving other equipment that is to remain or new equipment as indicated. Remaining piping and tubing shall be fitted with an appropriate blind flange or plug and insulated as required.
- D. CONTRACTOR shall remove equipment bases, anchor bolts, and other supports serving equipment to be removed. Concrete bases shall be removed to 1 inch below floor elevation and repaired with nonshrink grout plus surfacing to match existing.
- E. CONTRACTOR shall patch floors, walls, and ceilings as required to match existing or as indicated where equipment, piping, electrical, bases, or supports are removed.
- F. CONTRACTOR shall remove the following major equipment items or systems. The following list is not intended to be all-inclusive. CONTRACTOR shall remove all items indicated or specified to be removed: Pumps and controls.

### 3.04 INTERIOR PIPING, DUCTWORK, AND APPURTENANCES

- A. CONTRACTOR shall remove all piping, ductwork, and appurtenances as indicated. The location and elevations of existing piping are approximate.
- B. CONTRACTOR shall remove all supports for piping, ductwork, and appurtenances indicated to be removed. Repiping and connections to new piping shall be as specified for new piping. Remaining piping and tubing, not reconnected for new piping, shall be fitted with an appropriate blind flange or plugged and insulated as required.
- C. CONTRACTOR shall patch all holes resulting from removal of piping, ductwork, appurtenances, and their supports. Patching of concrete shall be with nonshrink grout and as indicated. Patching of masonry shall be with matching material toothed in. Patch other material as indicated.

### 3.05 SALVAGE

- A. OWNER has first right of refusal to all material, piping, and equipment removed.
- B. All equipment, material, and piping, except as specified hereinafter, within the buildings and structures to be demolished and additional items as noted shall be removed by CONTRACTOR. CONTRACTOR shall inspect each structure and determine the type and amount of equipment, materials, and piping to be removed.

- C. All equipment, material, and piping, except as specified hereinafter, within the limits of the demolition and additional items noted to be removed, will become the property of CONTRACTOR if OWNER does not claim under first right of refusal and shall be removed from the project site. Comply with State and local ordinances and regulations for disposing of materials.

### 3.06 BACKFILL

- A. CONTRACTOR shall fill all abandoned structures and excavations resulting from removal of structures and utilities with compacted fill. See Section 31 23 00–Excavation, Fill, Backfill, and Grading for required degree of compaction.

END OF SECTION

## SECTION 03 01 30

### CONCRETE SURFACE REPAIR

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Miscellaneous concrete surface repairs.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Repair Locations: Existing wet well walls. There is estimated to be approximately 60 cubic feet of wall vertical surface repairs.
- D. All concrete repair work noted on the drawings and in the specifications and the estimated concrete surface repair shall be included in the Lump Sum Bid.

##### 1.02 SUBMITTALS

- A. Comply with Section 01 33 00–Submittals.
- B. Product Data: Submit manufacturer's technical data sheets for each product.
- C. Submit list of project references as documented in this specification under 1.03 Quality Assurance. Include contact name and phone number of person charged with oversight of each project.

##### 1.03 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer Qualifications: Company with minimum 15 years of experience in manufacturing of specified products and systems.
  - 2. Applicator Qualifications:
    - a. Company with minimum of 5 years experience in application of specified products and systems on projects of similar size and scope, and is acceptable to product manufacturer.
    - b. Successful completion of a minimum of five projects of similar size and complexity to specified Work.

##### 1.04 PROJECT CONDITIONS

- A. Environmental Requirements:
  - 1. Application range of repair mortar is from 20°F (min 7°C) to 85°F (29°C). Follow ACI-recommended concreting practices for hot or cold weather.
  - 2. Frost or frozen surfaces shall be thawed and dry.
  - 3. Do not apply material if snow, rain, fog, or mist is anticipated within 12 hours after application. Allow surfaces to attain temperature and conditions specified before proceeding with application.

## PART 2-PRODUCTS

### 2.01 MANUFACTURER

- A. Repair materials shall be by Master Builders Solutions, or equal.

### 2.02 MATERIALS

- A. Vertical Wall Surface Repairs: Repair mortar shall be one component, rheoplastic, shrinkage-compensated, fiber-reinforced, cementitious repair mortar, MasterEmaco® S 488CI by Master Builders Solutions, or equal.
- B. Reinforcing Primer: Primer for reinforcing shall be a 2-component liquid epoxy bonding agent and anticorrosion coating, MasterEmaco® ADH 326 by Master Builders Solutions, or equal.

## PART 3-EXECUTION

### 3.01 IDENTIFICATION

- A. When various tanks and other structures are removed from service and are available for inspection, CONTRACTOR and ENGINEER shall observe conditions and identify areas to be repaired. Where practicable, approximate quantities of repair material shall be agreed upon prior to commencement of repairs. Where quantities may be affected by subsurface conditions not visible prior to repairs, quantities shall be determined and agreed upon as soon as practicable after removal of unsound concrete.

### 3.02 SURFACE PREPARATION

- A. Protect adjacent Work areas and finish surfaces from damage during repair work.
- B. Concrete:
  1. Remove unsound or delaminated concrete, providing minimum of 1/4-inch (6 mm) substrate profile and 3/4-inch (19 mm) clearance behind corroded reinforcing steel.
  2. After removal of concrete, but before placement, mechanically abrade concrete surface to remove bond-inhibiting materials and to provide additional mechanical bond. Do not use method of surface preparation that will fracture concrete. Verify absence of microcracking or bruising according to ICRI Guideline No. 310.2.
  3. Sawcut straight edges along repair area perimeters minimum of 1 inch (25 mm) deep to eliminate feather edges. Do not cut reinforcement.
  4. Report cracks that appear in interface area of patch or overlay to ENGINEER, and repair.
  5. Continue expansion and control joints through repair or as required, review with ENGINEER.
  6. Dampen base concrete interface to be repaired to saturated surface dry (SSD) conditions by wetting, fogging, or ponding with clean water for 24 hours.

- C. Reinforcing Steel:
  - 1. Expose full circumference of corroded steel in areas to be repaired.
  - 2. Remove oxidation and scale from exposed reinforcing steel according to ICRI Technical Guideline No. 310.1R *Guide to Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion*.
  - 3. To prevent future steel corrosion, coat prepared reinforcing steel with reinforcing primer as specified.
  - 4. Any existing reinforcement displaced by prior demolition operations shall be bent back into place.

### 3.03 INSTALLATION

- A. Substrate shall be SSD with no standing water during application.
- B. Mix components and apply concrete according to manufacturer's instructions.
- C. Repair areas shall be water-cured for 7 days or use an approved curing compound compatible with coatings if area is to be overcoated.

END OF SECTION

SECTION 03 11 00  
CONCRETE FORMWORK

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Forms for cast-in-place concrete.
  - 2. Form accessories.
  - 3. Openings for other work.
  - 4. Form stripping.
  
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 117-Tolerances for Concrete Construction.
- B. ACI 301-Structural Concrete for Buildings.
- C. ACI 318-Building Code Requirements for Reinforced Concrete.
- D. ACI 347-Recommended Practice for Concrete Formwork.
- E. PS1-Construction and Industrial Plywood.

1.03 DESIGN

- A. All formwork shall comply with ACI 347 and ACI 301.
- B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00-Submittals for form ties, form coatings, form liners (if any), and any other form accessories.

PART 2-PRODUCTS

2.01 FORMS

- A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of ENGINEER.



- B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

## 2.02 FORM TIES–NONREMOVABLE

- A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall have cones on the water side of water-containing structures. Ties shall also have cones on the exterior side of all structures which have PVC water-stopped construction joints. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.
- B. All wall ties used in the placement of structures which have PVC or hydrophilic water-stopped construction joints shall contain integral waterstops. All such ties shall be crimped or deformed in such a manner that the bond between concrete and tie cannot be broken in removal of the outer units. This portion of the tie shall not be removed prior to 24 hours after completion of the concrete placement.
- C. The use of wood spacers and wire ties will not be approved.

## 2.03 FORM TIES–REMOVABLE

- A. Taper ties which are designed to be removed entirely from the wall may be used with forms designed for this tie type and spacing.
- B. Tie holes shall be plugged with either a neoprene plug, Sure-Plug by Dayton Superior, Inc., or an EPDM rubber plug, X-Plug by Sika Greenstreak, or equal.
- C. Cementitious waterproofing material for patching taper tie holes shall be Hey Di K-11, Xypex Patch-N-Plug, or equal. Taper tie holes above the normal operating water surface shall be patched with mortar mix as specified in Section 03 30 00–Cast-in-Place Concrete for patching tie holes.

## 2.04 FORM COATINGS

- A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

## 2.05 CHAMFER STRIPS

- A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

## 2.06 KEYWAYS

- A. Keyways shall be formed with wood inserts.

## PART 3-EXECUTION

### 3.01 CONSTRUCTION

- A. Forms shall conform to the shape, line, grade, and dimensions as shown on the drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape. Spacing of ties shall be recommended by the tie manufacturer.
- B. Formwork and finished concrete construction shall meet the tolerances specified in ACI 117.
- C. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
- D. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.
- E. At the request of ENGINEER, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.
- F. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.
- G. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.
- H. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to allow for ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.
- I. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.
- J. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to review of ENGINEER.

### 3.02 FORM REMOVAL

- A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.
- B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete.

- C. Forms shall not be removed before the expiration of the minimum times as stated below or until the concrete has attained its minimum 28-day design strength as confirmed by concrete cylinder tests, unless specifically authorized by ENGINEER.
1. Wall and vertical faces: 24 hours.
  2. Columns: 24 hours.
  3. Beams and elevated slabs: 14 days.

END OF SECTION

## SECTION 03 20 00

### CONCRETE REINFORCEMENT

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work includes providing complete, in-place, and all steel required for reinforcement of cast-in-place concrete as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. Applicable standards listed in this section include, but are not necessarily limited to the following:
  - 1. ACI 315–Manual of Standard Practice for Detailing Reinforced Concrete Structures.
  - 2. ACI 318–Building Code Requirements for Reinforced Concrete.
  - 3. ASTM A1064–Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - 4. ASTM A615–Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 5. ASTM A996–Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcing.
  - 6. ASTM C1116–Standard Specification for Fiber-Reinforced Concrete.
  - 7. CRSI–Manual of Standard Practice.

##### 1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00–Submittals.
- B. Provide complete shop drawings of all material to be furnished and installed under this section:
  - 1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of ENGINEER on reinforcing bar lists and placing drawings.
  - 2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
  - 3. Shop drawings shall be in accordance with ACI 315.

##### 1.04 PRODUCT HANDLING

- A. Delivery:
  - 1. Deliver reinforcement to the job site bundled, tagged, and marked.
  - 2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

## PART 2--PRODUCTS

### 2.01 MATERIALS

- A. Reinforcing bars shall comply with ASTM A615 or A996 Type R, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.
- B. Steel wire and welded wire fabric shall comply with ASTM A1064. Fabric shall be provided in flat sheets. Rolled fabric shall not be used.
- C. Reinforcement supports including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
  - 1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
  - 2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
  - 3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
  - 4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.

### 2.02 FABRICATION

- A. General:
  - 1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
  - 2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
  - 3. Unless otherwise shown on the drawings, all end hook dimensions shall conform with "ACI Standard Hooks."
- B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:
  - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
  - 2. Bend or kinks not indicated on drawings or final shop drawings.
  - 3. Bar with reduced cross section because of excessive rusting or other cause.

## PART 3--EXECUTION

### 3.01 INSPECTION

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.
- B. Correct conditions detrimental to the proper and timely completion of the work.

- C. Do not proceed until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

A. General:

1. Comply with the specified standards for details and methods of placing reinforcement and supports.
2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials which reduce or destroy bond with concrete.

B. Placing Reinforcement:

1. All reinforcing shall be placed in accordance with Contract drawings and with shop drawings stamped and approved by ENGINEER.
2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
4. Unless otherwise shown on the drawings, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
  - a. Three inches of cover where the concrete is placed directly against ground.
  - b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
  - c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
  - d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.
5. Reinforcement shall be positioned within  $\pm 3/8$ -inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be  $\pm 1/2$  inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.
6. Bars shall be securely tied at all intersections except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly if acceptable to ENGINEER. Tack welding of reinforcing will not be permitted.
7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at  $\pm 4$  feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3-foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4-foot 0-inch centers.
10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the drawings and specifications.

- C. Reinforcement Supports:
  - 1. Strength and number of supports shall be sufficient to carry reinforcement.
  - 2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
  - 3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.
  
- D. Welded Wire Fabric:
  - 1. Install welded wire fabric in as long of lengths as practicable.
  - 2. Lap adjoining pieces at least one full mesh.
  - 3. Fabric shall be supported with bar supports.
  
- E. Splices:
  - 1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
  - 2. Lap splices in reinforcing shall be provided as shown on the drawings. Where lap splice lengths are not shown on the drawings, provide Class B, Category 1 lap splices in accordance with ACI 318.
  - 3. Adjacent splices of tangential bars in circular slabs and horizontal bars in circular walls shall be staggered a minimum of one full lap splice length or 3 feet, whichever is greater, unless otherwise shown. Stagger dimension shall be measured from center to center of lap splices.
  - 4. For circular walls, horizontal bar lap splices shall not coincide in vertical arrays more frequently than every third bar.
  - 5. Mechanical splices and threaded dowel bar inserts may be used where approved by ENGINEER. Splices shall be capable of developing at least 125% of the yield strength of the reinforcing bar.
  
- F. Embedded Items:
  - 1. Allow other trades to install embedded items as necessary.
  - 2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.
  
- G. Minimum Reinforcing: Where reinforcing is not shown, provide a minimum of No. 4 at 8-inch centers each way in members 10 inches or less in thickness and No. 5 at 12-inch centers each way in each face in members greater than 10 inches thick.

END OF SECTION

## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All cast-in-place concrete as shown except as noted otherwise.
  - 2. Hydrophilic waterstops, expansion joint fillers, bonding agents, patching mortars, curing compounds, nonshrink grout, floor sealer, and other related items and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ACI 211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301—Specifications for Structural Concrete.
- C. ACI 304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R—Guide to Hot Weather Concreting.
- E. ACI 306R—Guide to Cold Weather Concreting.
- F. ACI 308—Specification for Curing Concrete.
- G. ACI 309—Guide for Consolidation of Concrete.
- H. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
- I. ASTM C31—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33—Standard Specification for Concrete Aggregates.
- K. ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C40—Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- M. ASTM C88—Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- N. ASTM C94—Standard Specification for Ready-Mixed Concrete.
- O. ASTM C143—Standard Test Method for Slump of Hydraulic-Cement Concrete.
- P. ASTM C150—Standard Specification for Portland Cement.



- Q. ASTM C156–Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.
- R. ASTM C172–Standard Practice for Sampling Freshly Mixed Concrete.
- S. ASTM C231–Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- T. ASTM C260–Standard Specification for Air-Entraining Admixtures for Concrete.
- U. ASTM C309–Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- V. ASTM C494–Standard Specification for Chemical Admixtures for Concrete.
- W. ASTM C618–Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- X. ASTM D1752–Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- Y. ASTM C652–Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
- Z. ASTM D994–Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

### 1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00–Submittals.
- B. Submit the following information:
  1. Gradation of fine and coarse aggregate–ASTM C33.
  2. Specific gravity and dry rodded density of each aggregate.
  3. Test of deleterious substances in fine and coarse aggregate–ASTM C33.
  4. Design mix of each individual concrete mix to be used.
  5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
  6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
  7. Brand, type, principal ingredient, and amount of each admixture to be used.
- C. It is important that the above data be submitted to ENGINEER well in advance of anticipated concreting operations to avoid any delay in construction.

## PART 2–PRODUCTS

### 2.01 CEMENT

- A. Cement shall be Portland cement conforming to ASTM C150. Cement used for structures exposed to wastewater, sludge, combined sewage, or sanitary sewage shall be Type II or Type I/II. All other cement shall be Type I or Type I/II. Type III cement shall be used only when permitted by ENGINEER. All cement shall be the product of one reputable manufacturer and mill.

- B. Cement shall be stored in a dry, weathertight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

2.02 FLY ASH

- A. All fly ash used as an admixture in Portland cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

2.03 AGGREGATE

- A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

Deleterious Substance	Aggregate	
	Fine	Coarse
Clay Lumps and Friable Particles	3.0	3.0
Coal and Lignite	0.5	0.5
Mineral finer than No. 200 sieve	3.0	
Soft Fragments	3.0	3.0
Chert*	---	5.0
Sum of Chert and Clay Lumps		5.0

\* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

- B. The combined amount of all deleterious substances in an aggregate shall not exceed 5% of the weight of the aggregate.
- C. If required by ENGINEER, sodium sulfate soundness tests (ASTM C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM C33. Certified test results shall be submitted to ENGINEER confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.
- D. Fine aggregate shall be well-graded from coarse to fine and shall conform to the following requirements:

Percentage by Weight	
Passing 3/8-inch sieve	100
Passing No. 4 sieve	95-100
Passing No. 8 sieve	80-100
Passing No. 16 sieve	50-85
Passing No. 30 sieve	25-60
Passing No. 50 sieve	5-30
Passing No. 100 sieve	0-10

- E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20 from the fineness modulus of the representative sample used in proportioning the concrete.
- F. If required by ENGINEER, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.
- G. Coarse aggregate shall be well-graded from coarse to fine, and when tested by laboratory sieves having square openings, shall conform to the following requirements:

	Percentage by Weight Aggregate	
	3/4-inch Stone	1 1/2-inch Stone
Passing 2-inch sieve	---	100
Passing 1 1/2-inch sieve	---	90-100
Passing 1-inch sieve	100	20-55
Passing 3/4-inch sieve	90-100	0-15
Passing 3/8-inch sieve	20-55	0-5
Passing No. 4 sieve	0-10	---
Passing No. 8 sieve	0-5	---

- H. The 3/4-inch aggregate shall be used in concrete members no thinner than 4 inches and less than 10 inches thick. A blend of 3/4-inch and 1 1/2-inch aggregate shall be used in members 10 inches thick and thicker with the 3/4-inch aggregate comprising between 35% and 65% of the total course aggregate. When members thinner than 10 inches are placed monolithically with members thicker than 10 inches, the aggregate requirements for the thinner member shall apply.
- I. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained, and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

#### 2.04 WATER

- A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

#### 2.05 ADMIXTURES

- A. Water Reducing Admixture shall be Master Pozzolith® 200 by Master Builders Solutions, Daracem 19 by Grace, or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.
- B. Air-Entraining Admixture shall be equal to MasterAir® AE 90 by Master Builders Solutions, Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.

- C. No other admixture will be allowed without written approval of ENGINEER. All admixture shall be compatible with cement, aggregate, and water used.

## 2.06 PROPORTIONING

- A. The proportions of aggregate to cement shall be such as to produce a workable mixture that can be thoroughly compacted and that will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.
- B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

Class	Maximum Water/ Cement or Water/ (Cement+Fly Ash)	Minimum 28 Day Strength-Pounds per Square Inch	Cement Content-Pounds per Cubic Yard	Fly Ash- Pounds per Cubic Yard	
				Type C	Type F
AA	0.42	4,500	611	---	---
A	0.45	4,000	564	---	---
A-FA	0.45	4,000	480	110	125

- C. Except as otherwise indicated on the drawings or specified, all concrete shall be Class A or Class A-FA concrete. New elevated slab shall be Class AA.
- D. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a competent concrete engineer or competent laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by ENGINEER. Mix computations shall be submitted if requested by ENGINEER.
- E. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable unless otherwise stated.
- F. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.
- G. An air-entraining admixture shall be used in all concrete except as noted. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between 4% to 7% by volume. An air-entraining admixture is not required for concrete patching and for concrete floors, equipment pads, and supports in interior heated buildings where the concrete will be protected from freezing during and after construction.
- H. CONTRACTOR shall submit to ENGINEER concrete cylinder compressive strength results from previous projects for the same concrete mixes proposed on the current project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained.

All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.

- I. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device that can be adjusted to deliver the desired amount of water.

## 2.07 WATERSTOPS

- A. Hydrophilic waterstop shall be a flexible hydrophilic natural rubber strip composed of nonvulcanized rubber and urethane polymer hydrophilic agent creating a moisture-activated, self-healing waterproofing compound.
- B. Hydrophilic waterstop shall be Adeka Ultraseal, or equal, products as follows. Construction Joints:
  1. Wall/slab thickness greater than 9 inches with double mat of reinforcing: MC-2010MN (3/4 inch by 3/8 inch) with embedded stainless steel wire mesh for expansion control. The waterstop shall develop a minimum of 400 psi expansion pressure and withstand a minimum 150-foot hydrostatic head. Expansion amount shall not exceed 120%.
  2. Wall/slab thickness between 4 inches and 9 inches with 1-inch minimum cover and single or double mat of reinforcing: KBA-1510FP (9/16 inch by 3/8 inch). Expansion amount shall not exceed 30%.

## 2.08 JOINT FILLER

- A. Expansion joints shall have standard 1/2-inch-thick cork expansion joint filler, W. R. Meadows, or equal, meeting ASTM D1752–Type II. Exceptions to this are expansion joints in exterior concrete walks and between concrete walks and other structures which shall be asphalt expansion joint filler, 1/2-inch-thick, Grace, W.R. Meadows, or equal, meeting ASTM D994.

## 2.09 BONDING AGENT

- A. Acceptable manufacturers include MasterProtect® P 110 by Master Builders Solutions (nonsubmerged locations), MasterEmaco® ADH 326 (submerged locations), or equal.

## 2.10 PATCHING ADDITIVE

- A. Acceptable manufacturers include MasterEmaco® A 660 by Master Builders Solutions, Sonocrete by Sonneborn Contech Co., or equal.

## 2.11 NONSHRINK GROUT

- A. Acceptable manufacturers include Dayton Superior, Master Builders Solutions, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

## 2.12 CURE–SEAL HARDENER

- A. Penetrating sealer for interior building floors shall be Ashford Formula by Curecrete Chemical Company, Inc., or equal. See drawings for locations to be used.

## PART 3-EXECUTION

### 3.01 MIXING

- A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304R. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.
- B. A representative of ENGINEER may be at the batching plant periodically to observe the batching and mixing.
- C. No water shall be added on the job unless required by CONTRACTOR and with the knowledge of ENGINEER; the amount of water, if added, shall be recorded on all copies of the delivery tickets. If water is added, CONTRACTOR shall verify that the required water-cement ratio is not exceeded.
- D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the jobsite.
- E. With each load of concrete, CONTRACTOR shall obtain delivery tickets and shall make these tickets available for review by ENGINEER. Delivery tickets shall provide the following information:
  - 1. Date.
  - 2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
  - 3. Type of cement and admixtures, if any.
  - 4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.
  - 5. Amount of concrete in load, in cubic yards.
  - 6. Water-cement ratio.
  - 7. Water added at job, if any.
  - 8. Truck number and time dispatched.
  - 9. Number of mixing drum revolutions.
- F. For job-mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. The mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive timing device that will positively prevent discharging the mixture until the specified mixing time has elapsed.

### 3.02 JOINTS

- A. CONTRACTOR shall place all joints as shown on the drawings or specified herein. If approved by ENGINEER, CONTRACTOR may, at his own expense, place construction joints in addition to and at places other than those shown on the drawings. Unless otherwise shown, all joints shall be straight, truly vertical or horizontal, and proper methods shall be employed to obtain this result.

- B. Where joints are not shown on the drawings or specified elsewhere, CONTRACTOR shall provide joints as follows:
  - 1. Walls shall have vertical joints at 60 feet on center maximum but not more than 15 feet from corners or intersections and shall have horizontal joints at 15 feet on center maximum.
  - 2. Slabs shall have joints at 20 feet on center maximum in each direction.
- C. Immediately after completion of the first pour at a joint, the concrete surface, reinforcement, and waterstop projecting beyond the joint shall be thoroughly cleaned and laitance removed. The waterstops shall not be disturbed after the concrete in the first pour at a joint has set. Concrete around waterstops shall be thoroughly compacted by hand spading and vibrating. Immediately before the second pour, all extraneous matter shall be removed from the joint, the waterstop and steel cleaned, and the surface thoroughly wetted.
- D. Concrete at all joints shall have been in place at least 48 hours before abutting concrete is placed. At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slab supported thereon. Beams, girders, brackets, column capital, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

### 3.03 WATERSTOPS

- A. Hydrophilic waterstop shall be provided at all construction joints between new and existing concrete. Waterstop shall be placed as shown on drawing details and in accordance with the manufacturer's recommendations.

### 3.04 BONDING TO EXISTING CONCRETE

- A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of new pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

### 3.05 PATCHING EXISTING CONCRETE

- A. When patching existing concrete, remove poor concrete until firm hard concrete is exposed; roughen and clean surface of the existing concrete, clean any exposed reinforcing bars, and pour new concrete. Concrete finish shall match existing concrete. New concrete shall be 4,000 psi 28-day strength mixed with patching additive, mixed according to manufacturer's instructions. Concrete shall not be air-entrained.

### 3.06 EMBEDDED ITEMS IN CONCRETE

- A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.
- B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
- C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

### 3.07 PLACING CONCRETE

- A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.
- B. After reinforcement is placed and before concrete is placed over it, ENGINEER shall be allowed sufficient time to observe the reinforcing.
- C. Unless otherwise authorized by ENGINEER, all concrete shall be placed in the presence of ENGINEER.
- D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the segregation or loss of materials. Chuting for conveying purposes must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.
- E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.
- F. Concrete in wall pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.
- G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation from rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. Once concreting is started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.
- H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas, vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.
- I. A sufficient number of spare vibrators shall be kept in ready reserve to provide adequate vibration in case of breakdown of those in use.
- J. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- K. No extra payment will be allowed for dewatering, undercutting, and gravel fill.



### 3.08 MOIST CURING

- A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:
1. Wood forms left in place and kept wet at all times. If wood forms are not going to be kept wet or if metal forms are used, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
  2. Use of a curing compound conforming to ASTM C309, Type I as approved by ENGINEER. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces that are to be painted, receive ceramic tile or resilient flooring, or be waterproofed. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
  3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.
  4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
  5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.
  6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
  7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."
- B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

### 3.09 HOT WEATHER CONCRETING

- A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.
- B. The temperature of the delivered concrete shall not exceed 85°F.
- C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the jobsite.
- D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.

- E. If approved by ENGINEER, an admixture for retarding the setting of the concrete may be used.
- F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

### 3.10 COLD WEATHER CONCRETING

- A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than 3 successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, except as modified by the requirements of these specifications.
- B. Detailed procedures for the production, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to ENGINEER. Cold weather concreting shall not begin until these procedures have been reviewed for conformance with ACI 3.06.1.
- C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.
- D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.
- E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.
- F. If heating is used, the housing shall be constructed weathertight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within 2 hours after concrete placement.
- G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.

- H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to provide compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for ENGINEER's use.
- I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.
- J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

### 3.11 FINISHING

#### A. Flat Work:

1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.
3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
4. Tolerance for concrete floors shall be 1/4 inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.
5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.
6. The above finishes shall be used in the following locations:
  - a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.
  - b. Light Troweled Finish: Submerged tank slabs.
  - c. Hard Troweled Finish: Building floors.
  - d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.

#### B. Formed Surfaces:

1. Within 2 days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots that appear shall be repaired. No extra compensation will be allowed CONTRACTOR for such work.
2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner such that it completely fills the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.

4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.
  5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by ENGINEER. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
    - a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all unpainted surfaces, interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel-faced forms are used to form walls, the portion of wall to receive the sack finish shall first be roughened by brush blasting or other acceptable method to achieve a texture similar to 40 to 60 grit sandpaper.
    - b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof- and moistureproof-coated surfaces.
    - c. Finish C shall be referred to as a finish that has surface imperfections less than 3/8 inches in any dimension. Surface imperfections greater than 3/8 inches shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.
    - d. Finish D shall be the finish for surfaces that may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.
- C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

### 3.12 LOADING OF CONCRETE STRUCTURES

- A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.
- B. Extreme care shall be taken so that construction loads do not exceed design loading of the structure.

### 3.13 NONSHRINK GROUT

- A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by ENGINEER. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

### 3.14 TESTING AND SAMPLING

- A. The following tests of fresh concrete shall be performed by CONTRACTOR. CONTRACTOR shall prepare, protect, transport, and have tested all cylinders at his expense.
  - 1. Sampling of concrete for slump tests, air tests, temperature tests, and for making concrete test cylinders shall be performed in accordance with ASTM C172.
  - 2. Cylinders:
    - a. Three test cylinders shall be made for each pour less than 25 cubic yards, four test cylinders shall be made for each pour between 25 and 100 cubic yards, and eight test cylinders shall be made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least four cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by ENGINEER.
    - b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F and 80°F and shall remain undisturbed and stored in a location free from vibration. In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the jobsite.
    - c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.
    - d. Cylinders shall be broken at 7 and 28 days or as requested by ENGINEER. Test results shall be mailed immediately and directly to ENGINEER. Test data shall include date and location of pour and concrete mix used.
  - 3. Slump Test: CONTRACTOR shall make one slump test near the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by ENGINEER. Slump tests shall conform to ASTM C143.
  - 4. Air Test:
    - a. When air-entrained concrete is used, the air content shall be checked by CONTRACTOR near the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards, or as requested by ENGINEER.
    - b. The air contents shall be checked using the pressure method in accordance with ASTM C231. The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.
- B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

### 3.15 RECORDS

- A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The project representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

### 3.16 CONCRETE REMOVAL AND PATCHING

- A. All areas disturbed as a result of concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

### 3.17 CURING AND SEALING INTERIOR BUILDING FLOORS

- A. Install cure-seal hardener product in accordance with manufacturer's instructions. Apply only to those floors noted to be sealed in the finish schedule.
- B. Where product will be used for moist curing, sealing and hardening, apply to new concrete as soon as the concrete is firm enough to walk on after troweling. Where product will be used for sealing and hardening only, surface must be free of dust, dirt, laitance, curing compounds, and any material that would inhibit the penetration of the product. In some instances, the floor may need to be stripped and neutralized before application.
- C. Spray on at rate of 200 square feet per gallon.
- D. Keep surfaces wet with cure-seal hardener for minimum soak-in period of 30 minutes, without allowing drying out or becoming slippery. In hot weather, slipperiness may appear before the 30-minute time period has elapsed. If that occurs, apply more cure-seal hardener as required to keep entire surface in a nonslippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a nonslippery state.
- E. After this period, when treated surface becomes slippery, lightly mist with water until slipperiness disappears.
- F. Wait for surface to become slippery again and then flush entire surface with water removing all residue of cure-seal hardener.
- G. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
- H. Wet vacuum or scrubbing machines may be used to remove residue, provided manufacturer's instructions are followed.
- I. Protect installed floors until chemical reaction process is complete; at least 3 months.
- J. Clean up spills immediately and spot-treat stains with good degreaser or oil emulsifier.
- K. Protection and cleaning of floors are the responsibility of CONTRACTOR until final completion. Replace concrete that becomes stained because of improper precautions or lack of cleaning.

END OF SECTION

SECTION 05 50 00  
METAL FABRICATIONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Shop-fabricated stainless steel items, including lateral pipe supports.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A176–Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
- B. ASTM A276–Stainless Steel Bars and Shapes.
- C. ASTM A992–Structural Steel Shapes.
- D. AWS A2.0–Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- E. AWS A5.4–Stainless Steel Electrodes for Shielded Metal Arc Welding.
- F. AWS D1.2–Structural Welding Code–Aluminum.
- G. AWS D1.6–Structural Welding Code–Stainless Steel.

1.03 DESIGN REQUIREMENTS

- A. All fabrications shall meet applicable code requirements including OSHA.

1.04 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01 33 00–Submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.
- C. Mill Test Reports: Submit indicating structural strength and composition.
- D. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

- A. Fabricate steel members in accordance with AISC Code of Standard Practice.

- B. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

#### 1.06 QUALIFICATIONS

- A. Qualify welding processes and welding operators in accordance with AWS *Standard Qualifications Procedures*.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to provide uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

### PART 2-PRODUCTS

#### 2.01 MATERIALS-STAINLESS STEEL

- A. Unless otherwise noted, all stainless steel shall meet the requirements of ASTM A276 and shall be Type 316L.
- B. Unless otherwise noted, all stainless steel bolts shall meet the requirements ASTM F593 and shall be Type 316L.
- C. Unless otherwise noted, all stainless steel nuts shall meet the requirements of ASTM F594 and shall be Type 316L.
- D. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.
- E. Welding Electrodes:
  - 1. Comply with AWS D1.6.
  - 2. Use ER316L electrodes for 316L stainless steel.
  - 3. Use ER308L electrodes for 304L stainless steel.

#### 2.02 FABRICATION

- A. Fabrication and Assembly:
  - 1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
  - 2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.



3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
  4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
  5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
- B. Connections:
1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
  2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
  3. Assemble and weld built-up sections to produce true alignment of axes without warp.
  4. Welding shall be done by the shielded arc process.
  5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.
- C. Workmanship:
1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.
  2. Work to dimensions shown or accepted on the Shop drawings using proven details of fabrication and support.
  3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
  4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
  5. Cap all open ends of pipe and structural tubing.
  6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
  7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
  8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

## PART 3—EXECUTION

### 3.01 EXAMINATION

- A. Correct conditions detrimental to the proper and timely completion of the work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.
- B. Coordinate delivery of such items to project.

- C. Clean and strip primed steel items to bare metal where site welding is required.

### 3.03 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement:
  - 1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.
  - 2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
  - 3. Fit exposed connections accurately together to form tight hairline joints.
  - 4. Weld connections that are not to be left as exposed joints, grind joints smooth, and touchup shop paint coat or galvanizing repair.

### 3.04 FIELD WELDING

- A. Comply with AWS Code for procedures of manual shielded metal arc welding (steel, stainless steel) and gas metal arc welding (aluminum), appearance and quality of weld made, and methods in correcting welding work.

END OF SECTION

## SECTION 05 51 33.23

### ALTERNATING TREAD ALUMINUM STAIRS

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: Aluminum alternating tread stair assemblies in accordance with the requirements set forth in this section.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. National Association of Architectural Metal Manufacturers (NAAM): AAMM, STANDARD AMP 510-92 Metal Stairs Manual 5th Edition.
- B. Aluminum Association: Aluminum standards and data, latest Edition.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Alternating Tread Stair Treads: shall be capable of withstanding a single concentrated 1,000-pound load without permanent deformation; or 100 pounds per square foot or 300 pounds on an area of 4 square inches without exceeding the allowable working stress of the material.
- B. Alternating Tread Stair Guard and Handrail: shall be capable of withstanding a single concentrated load of 200 pounds or a uniform load of 50 pounds per linear foot applied in any direction at any point on the rail without exceeding the allowable working stress of the material.
- C. Alternating Tread Stair Stringers: shall be capable of withstanding a single concentrated load of 1000 pounds at any point on the stair without permanent deformation; or a uniform live loading of 100 pounds per square foot applied in a downward direction to all tread surfaces or a 300-pound load on an area of 4 square inches without exceeding the allowable working stress of the material.

##### 1.04 CONSTRUCTION REQUIREMENTS

- A. Cast Aluminum Treads, Landings, and Mounting Base: shall be shielded metal arc welded to a single extruded box-like stringer.
- B. Tread Castings: shall have integrally cast handrail support arms which are precision machined and welded to continuous aluminum handrails.
- C. Pedestrian Surfaces: shall be cast with skid resistant surfaces and all treads shall have upturned integrally cast skid barriers.

- D. Riser Spacing: shall be equally spaced to within 3/16-inch for adjacent and to within 3/8-inch for any two non-adjacent risers on a stair.
- E. Guards and Handrails: shall be contoured for body guidance and underarm support, and shall have inclined hand side portions for free sliding of the hands unimpeded by the handrail supports.
- F. Cast Aluminum Foot Divider: shall be an integral part of the landing and shall form a support for a rubber bumper strip.

#### 1.05 DIMENSIONS

- A. Alternating Tread Stair Angle: 68 degrees from horizontal as specified in the drawings.
- B. Vertical Drop: the change in elevation, as shown in the drawings, between the upper finished floor surface where the top landing will be attached and the lower finished floor surface where the base of the alternating tread stair will be secured.

#### 1.06 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00–Submittals.
- B. Dimensional Prints: shall be submitted for approval prior to fabrication.

#### 1.07 DELIVERY STORAGE AND HANDLING

- A. Deliver materials to the job-site in good condition and properly protected against damage to finished surfaces.
- B. Store material in a location and manner to avoid damage. Do not stack components. Lay out components on firm foundation material such that bending cannot occur.
- C. Store metal components in a clean dry location, away from uncured concrete, cement, or masonry products, acids, oxidizers, rain water, or any other chemical or substance that might damage the material or finish.
- D. Plan work and storage locations to keep on-site handling to a minimum.
- E. Exercise particular care to avoid damage to material finishes or unprotected surfaces when handling.

### PART 2–PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Lapeyre Stair, Inc., or equal  
5117 Toler Street  
Harahan, LA 70123  
1-(800)-535-7631 or  
1-(504)-570-6209

## 2.02 MATERIALS:

- A. Landings, Treads and Foot Castings: Aluminum alloy F356F.
- B. Guards/Handrails:
  - 1. Aluminum Alloy 6063-T4.
  - 2. 1 1/2-inch diameter by 1/8-inch Tube.
- C. Central Stringer:
  - 1. Aluminum Alloy 6063-T52.
  - 2. 1 3/4-inch by 4-inch by 1/8-inch Box Shape.
- D. Miscellaneous Materials:
  - 1. Rubber Spine: Hollow neoprene strip
  - 2. Bolts: Landing to Structure, ASTM A307, 1/2-inch diameter, Stainless Steel.
  - 3. Nuts: ASTM A563, Stainless Steel.
  - 4. Washers: ASTM F844, Stainless Steel.

## 2.03 FINISH

- A. Natural Finish.

## 2.04 FABRICATION

- A. General: Fabricate alternating tread aluminum stairs to conform with performance and construction requirements, and in accordance with approved shop drawings or dimensional prints. Fabricate and shop-assemble to greatest extent possible.
- B. Fabricate gas metal arc welded and/or gas tungsten arc welded alternating tread aluminum stairs using the specified materials.

## PART 3—EXECUTION

### 3.01 PREPARATIONS

- A. Coordination: Coordinate start and installation of aluminum alternating tread stairs with all other related and adjacent work. Installation shall not start until the construction has progressed to the point that weather conditions and remaining construction operations will not damage stair installation.
- B. Verification: Verify that dimensions and angle are correct and that substrate is in proper condition for alternating tread stair installation. Do not proceed with installation until all necessary corrections have been made.

### 3.02 INSTALLATION

- A. Prepare mounting holes.
- B. Position alternating tread stair with top tread at same elevation as upper finished floor or roof surface.

- C. Secure alternating tread stair with not less than 2 bolts or studs at top and with not less than 2 at bottom of stair.

3.03 CLEANUP

- A. Leave work areas clean and free of debris.

END OF SECTION

## SECTION 05 52 00

### HANDRAILS AND RAILINGS

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work includes aluminum railings, fittings, and self-closing gates.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A53-Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM B241-Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

##### 1.03 DESIGN REQUIREMENTS

- A. Railings and self-closing gates shall be designed in accordance with and meet the applicable requirements of the Occupational Safety and Health Act and the Wisconsin Commercial Building Code.
- B. Submit engineering calculations for all rails, posts, and connections demonstrating compliance with the design requirements. Calculation shall be stamped by a Wisconsin Professional Engineer.

#### PART 2-PRODUCTS

##### 2.01 ALUMINUM RAILING SYSTEM

- A. Provide a mechanically joined pipe railing system, Tabco 2500 Railing System as manufactured by Tuttle Aluminum and Bronze Co. or equal.
- B. Rails shall be ASTM B241, Aluminum Alloy 6063-T6, 6005-T5, or 6105-T5 Schedule 40, 1 1/2-inch-diameter pipe extrusion.
- C. Posts shall be ASTM B241, Aluminum Alloy 6063-T6, 6005-T5, or 6105-T5 Schedule 40, 1 1/2-inch-diameter pipe.
- D. Furnish and install 4-inch by 1/4-inch toeboards where shown or noted on the drawings, or where required by OSHA 1910.29(k).
- E. Furnish and install self-closing aluminum gates with stainless steel torsion springs at openings in railings providing points of access as shown on the drawings.

- F. Provide expansion joints in railing and toeboards at expansion joints in structures and as necessary to prevent buckling or buildup of stresses. Expansion joints shall occur within 1 foot of posts.
- G. Finished joints shall be smooth.
- H. All rails, posts, toeboards, and connectors shall have a M10C22A41 clear anodized finish.
- I. Posts shall be anchored to the top of walls and decks with a flange base plate. Base plate shall reinforce the bottom end of the post as required to meet OSHA design criteria.
- J. Stainless steel expansion bolt anchoring system, in accordance with manufacturer's recommendations, shall be used.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.
- B. Install components plumb and level, accurately fitted, and free from distortion or defects.
- C. Clean all components as recommended by railing manufacturer.
- D. Self-closing gates shall be installed to slide or swing away from the open edge (toward platform or walking surface).

END OF SECTION



## SECTION 05 53 00

### GRATING

#### PART 1--GENERAL

##### 1.01 SUMMARY

- A. Work includes floor grating.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A123--Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. NAAMM Metal Bar Grating Manual ANSI NAAMM MBG531 and MBG532.
- C. ASTM B221--Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Floor grating shall be designed for a maximum deflection of 1/4 inch when supporting a 100 psf uniform load.

##### 1.04 FIELD MEASUREMENTS

- A. Take all field measurements prior to preparation of shop drawings. Verify that field measurements are as indicated on shop drawings.

#### PART 2--PRODUCTS

##### 2.01 ALUMINUM FLOOR GRATING

- A. All grating, unless otherwise specified, shall be rectangular bar style, swage-locked aluminum floor grating with serrated surface.
- B. Acceptable manufacturers include the following or equal: Harsco Industrial, IKG Type S-19-4-BS.
- C. All edges of the grating and all openings in the grating for pipe and miscellaneous equipment shall be banded by welding on minimum 1/8-inch-thick bars. The band shall have less depth than the bearing bars to permit drainage.
- D. Individual sections shall be of a size to permit ease in handling with a maximum length not in excess of 8 feet. Weight of individual sections shall not exceed 75 pounds.

- E. All aluminum grating support angles shall be aluminum. Support angles shall be provided at the bearing ends of all grating. This includes locations such as wall openings and corners. Support angles shall also be provided at the nonbearing ends of grating where shown on the drawings.

## 2.02 FINISHES

- A. Protection of Aluminum from Dissimilar Materials: Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry, or lime mortar, exposed aluminum surfaces shall be painted with multiple coats of bituminous paint, minimum 10 mils dry, or other approved insulating material.

## PART 3-EXECUTION

### 3.01 EXAMINATION

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Prior to installation, CONTRACTOR shall inspect supports for correct size, layout, and alignment. Any inconsistencies between contract drawings and supporting structure deemed detrimental to placement shall be reported in writing to ENGINEER prior to placement.

### 3.02 INSTALLATION

- A. Place embedded frames and supports in correct position, plumb and level. Provide blocking as required to maintain alignment of sections.
- B. Seal small gaps between embedded angles at face of wall with backer rod to prevent concrete entry.
- C. All aluminum floor grating and plank shall be secured to supporting members with aluminum or stainless steel saddle clips supplied by the grating manufacturers. Stud bolts and other hardware shall be supplied by CONTRACTOR.
- D. Install in accordance with shop drawings and standard installation clearances as recommended by the NAAMM Metal Bar Grating Manual.
- E. Cutting, Filling, and Placement:
  - 1. Perform all cutting and fitting required for installation.
  - 2. Cutouts for circular obstructions are to be at least 2 inches larger in diameter than the obstruction. Cutouts for all piping 4 inches or less shall be made in the field.
  - 3. All rectangular cutouts are to be made to the next bearing bar beyond the penetration with a clearance not to exceed bearing bar spacing.
  - 4. Utilize standard panel widths wherever possible.

END OF SECTION

## SECTION 05 56 00

### ANCHOR BOLTS AND POST-INSTALLED ANCHORS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Anchor bolts, expansion bolts, adhesive anchors, and screw anchors.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
- B. ASTM F1554—Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.
- C. ICC-ES International Code Council—Evaluation Service.
- D. AC 193—Acceptance Criteria for Mechanical Anchors in Concrete Elements.
- E. AC 308—Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete.
- F. ACI 355.2—Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
- G. ACI 355.4—Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

#### PART 2—PRODUCTS

##### 2.01 ANCHOR BOLTS

- A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.
- B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

##### 2.02 EXPANSION BOLTS

- A. Expansion bolts shall be KWIK Bolt TZ by Hilti, Inc., Power-Stud + SD2, SD4, or SD6, by Dewalt, Strong-Bolt or Strong-Bolt 2 by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All expansion bolts shall comply with the Wisconsin Commercial Building Code, AC 193, and ACI 355.2. They shall be ICC-ES approved for use in cracked and uncracked concrete.

- C. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of ENGINEER or where otherwise specifically called for.
- D. Unless indicated otherwise on the drawings or specified, use the following bolt material for the various installation situations:
  - 1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
  - 2. Steel: In other locations in contact with items to be painted or encased in concrete.

### 2.03 ADHESIVE ANCHORS

- A. Adhesive anchors shall be HIT HY 200 by Hilti, Inc., Red Head C6+ or Red Head A7+ by ITW, Pure110+ or AC200+ by Dewalt, Set-XP by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All adhesive anchors shall comply with the Wisconsin Commercial Building Code, AC 308, and ACI 355.4. They shall be ICC-ES approved for use in cracked and uncracked concrete.

### 2.04 SCREW ANCHORS

- A. Screw anchors shall be KWIK HUS-EZ by Hilti, Inc., Screw-Bolt+ by Dewalt Systems, Titen-HD by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All screw anchors shall comply with the Wisconsin Commercial Building Code. They shall be ICC-ES approved for use in cracked and uncracked concrete.

## PART 3-EXECUTION

### 3.01 ANCHOR BOLTS

- A. Anchor bolts for structural members shall be located as shown and specified.
- B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.
- C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

### 3.02 EXPANSION BOLTS

- A. Unless otherwise noted on the drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's printed installation instructions.
- B. Bolt embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.

- D. Where location of bolts is adjustable, reinforcing steel shall be located prior to drilling holes and bolts shall be located to clear reinforcing steel.

### 3.03 ADHESIVE ANCHORS

- A. At locations shown on the drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.
- B. All existing surfaces to receive adhesive anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.
- E. CONTRACTOR shall arrange an anchor manufacturer's representative to provide on-site installation training for installation of their adhesive anchor system products. Submit documentation that all CONTRACTOR's personnel or subcontractors who install adhesive anchors have been trained prior to the announcement of anchor installation.

### 3.04 SCREW ANCHORS

- A. Unless otherwise noted on the drawings, screw anchor edge distance and spacing shall be in accordance with manufacturer's recommendations.
- B. Anchor embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.

END OF SECTION

## SECTION 07 90 00

### CAULKING AND SEALANTS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Caulking and sealants on the project, including primers and backer rod material.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM C920–Elastomeric Joint Sealants.

##### 1.03 SUBMITTALS

- A. Submittals shall comply with provisions of Section 01 33 00–Submittals.
- B. Submit color chart for each sealant used on project. Colors will be selected by ENGINEER.
- C. Submit copies of warranty.

##### 1.04 WARRANTY

- A. Caulked joints shall be weathertight and guaranteed watertight by installer for two years from the date established for Substantial Completion of the project. Deliver original guarantee to OWNER with copies to ENGINEER.

#### PART 2–PRODUCTS

##### 2.01 CAULK–NONSUBMERGED APPLICATIONS–GENERAL

- A. Caulk for nonsubmerged applications in all locations except floor joints shall be a one-part polyurethane sealant.
- B. Acceptable products include the following, or equal:
  - 1. Masterseal NP1 by Master Builders Solutions.
  - 2. Vulkem 116 by Tremco, Inc. (exterior applications only).
  - 3. Dymonic 100 by Tremco, Inc.

##### 2.02 CAULK–NONSUBMERGED APPLICATIONS–FLOOR JOINTS

- A. Caulk for floor joints in nonsubmerged applications shall be a one-part, self-leveling, polyurethane sealant.

- B. Acceptable products include the following, or equal:
  - 1. SL1 by Master Builders Solutions.
  - 2. Vulkem 45 SSL by Tremco, Inc.

### 2.03 CAULK–SUBMERGED APPLICATIONS

- A. Caulk in all submerged applications shall be an NSF/ANSIS Standard 61-approved two-part, polysulfide base synthetic rubber sealant.
- B. Acceptable products include the following, or equal:
  - 1. Sika Duoflex NS by Sika Corporation.
  - 2. Thiokol 2235M by PolySpec.

### 2.04 ACCESSORIES

- A. Backer rod shall be flexible, closed-cell polyethylene rod stock sized to be under at least 25% compression when positioned in the joint. In shallow joints and where backer rod is not used, polyethylene bond breaker tape shall be used. It is essential that the caulk bond to the side of the joint but not to the base of the joint.
- B. Primer(s) shall be used where required by the manufacturer for the specific product(s) used and the specific application(s) intended. Specific product(s) shall be as recommended by the manufacturer.
- C. Cleaning fluid shall be methyl ethyl ketone (MEK), methyl isopropyl ketone (MIK), or similar solvent material which will not etch or mar metal finishes and shall be the product of a nationally recognized manufacturer, of type expressly recommended for use with the caulking or sealant compound used.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Seal completely all joints around entire perimeter of all openings in all exterior walls (inside and outside faces), including joints at all exterior doors, windows, louvers, sills, and elsewhere as noted on the drawings and as necessary to seal all open joints in the building in a complete manner. Joints in exterior walls shall be caulked in a completely weathertight manner. Joints between interior walls and concrete ceilings and other interior joints shall be caulked as indicated on the drawings. Caulking not specified in other sections shall be performed under this heading.
- B. All caulking shall be done in accordance with manufacturer's specifications. Allow minimum 28-day curing period for concrete, grout, or mortar prior to caulking unless requested otherwise. Caulking work shall be done before the final coat of paint is applied except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting. All caulking shall occur only when the temperature is above 40°F.
- C. Joints shall be thoroughly cleaned and primed before caulking in accordance with manufacturer's instructions. Unless otherwise shown, joints shall be square in cross section 1/2-inch by 1/2-inch and shall comply with manufacturer's joint width/depth ratio limitations.

- D. Backer rod shall be used in all openings 3/4 inches or more in depth and shall be tightly packed to completely fill the space to 1/2-inch back of face. The 1/2-inch shall then be filled with caulking compound.
- E. Caulking shall be done by hand gun. Compound shall be driven into joint grooves with sufficient pressure to force out all air and fill joint grooves solidly. Caulking where exposed shall be free of wrinkles and shall be uniformly smooth.
- F. At completion of caulking, clean off all excess material from adjoining surfaces and material. Entire installation shall be left in a perfect appearing weathertight condition.

END OF SECTION



## SECTION 08 31 13

### ACCESS DOORS AND FRAMES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work included: Aluminum floor doors and frame units.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

#### PART 2—PRODUCTS

##### 2.01 ALUMINUM FLOOR DOORS AND FRAMES

- A. Acceptable products include the following, or equal: The Bilco Company, Type J.
- B. Type J doors shall be designed for H-20 loading.
- C. Doors shall be constructed of stiffened 1/4-inch aluminum diamond-pattern plate.
- D. Channel frame for Type J doors shall be 1/4-inch extruded aluminum with bend-down anchor tabs. Depth of frame shall be 6 inches. A continuous EPDM gasket shall be mechanically attached to the frame around the entire perimeter.
- E. Hinges shall be through bolted to the door and frame with tamper-proof Type 316 stainless steel lock bolts.
- F. Provide 1 1/2-inch drain coupling located in corner of channel frame for Type J doors.
- G. Type J doors shall be equipped with required number and size of compression spring operators for door to operate easily and smoothly. Provide heavy-forged cam-action hinges to open door so edge of door does not open into channel. Doors shall have smooth controlled operation and not be affected by temperature.
- H. Provide hold-open arm that automatically locks in open position. Provide snap lock with fixed handle mounted to underside of cover. Provide removable exterior turn/lift handle with spring-loaded ball detent to open cover. All hardware shall be Type 316 stainless steel for corrosive environment.
- I. Provide stainless steel unistruts, as necessary, attached to doors to mount accessories. Accessories (upper guide holder, cable holder, power and float cable holder, etc.) shall be stainless steel.
- J. A locking device shall be provided to prevent unauthorized entry into the confined space.

## 2.02 FINISH

- A. Aluminum floor doors and frames shall have mill finish. Apply bituminous coating to portions of frames in contact with concrete.
- B. Steel access doors shall have shop-applied prime coat compatible with field paint system specified.

## 2.03 ACCESSORIES

- A. All aluminum floor/door openings shall be fitted with a permanently installed, fall-through prevention grating system that is easily retractable for access to the opening below. Grating system shall be factory installed by access door manufacturer.
- B. Performance Characteristics:
  - 1. Grating panel(s) shall be high visibility safety yellow in color.
  - 2. Grating panel(s) shall lock automatically in the full open position.
  - 3. Grating system shall have a twenty-five year warranty.
  - 4. Grating panel(s) shall have a provision for locking to prevent unauthorized opening.
- C. Grating: Panels shall be aluminum with a powder coat paint finish and designed to meet OSHA 1926.502(c) and 1910.29 requirements for fall protection.
- D. Hold Open Feature: A Type 316 stainless hold open device shall be provided to lock the cover in the fully open 90 degree position.
- E. Hardware: All hardware shall be Type 316 stainless steel.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
- B. Provide piping from channel frames for Type J floor doors from outlet to base of wall nearest floor drain or through wall to ground for tank structures. Terminate pipe in minimum 1 cubic foot of clear stone if termination is below ground.
- C. Coordinate final size and location of door to provide proper clearance between door, safety grating, and pumps and to allow for proper placement of pumps in wetwell.

### 3.02 ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer that will not damage finish.
- B. Test units for proper function and adjust until proper operation is achieved.
- C. Repair finishes damaged during installation.

- D. Restore finishes so no evidence remains of corrective work.

END OF SECTION

## SECTION 09 91 00

### PAINTING

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: Surface preparation and application of paints and coatings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM B117-Standard Practice for Operating Salt Spray (Fog) Apparatus.
- B. ASTM D2247-Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity.
- C. ASTM D3363-Standard Test Method for Film Hardness by Pencil Test.
- D. ASTM D4060-Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- E. ASTM D4541-Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. ASTM D4585-Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- G. SSPC-The Society for Protective Coatings-Steel Structures Painting Manual.
- H. NACE-National Association of Corrosion Engineers.
- I. ICRI-International Concrete Repair Institute.
- J. Federal Register-Code of Federal Regulations (CFR).
- K. Federal Register-Resource Conservation and Recovery Act (RCRA).
- L. Federal Register-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

##### 1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00-Submittals.
- B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.

- C. Submit two copies of manufacturer's Safety Data Sheets (SDS) for each type of paint with each shop drawing submittal. SDS sheets shall be posted at the construction site at all times painting is in progress.
- D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in paragraph 2.01.

#### 1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
- B. Prepainting Meeting:
  - 1. A prepainting meeting shall be held immediately following the project preconstruction conference. The prepainting meeting is to be held prior to any material and equipment that requires painting is delivered to the site.
  - 2. CONTRACTOR, the paint subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
  - 3. The paint manufacturer's representative shall review progress at the site as requested by ENGINEER. These are generally expected to be prior to monthly progress meetings.

#### 1.05 FIELD QUALITY CONTROL

- A. Furnish testing apparatus as applicable for observing surface preparation, testing atmospheric conditions and testing coatings, prior to beginning surface preparation. Provide the following apparatus:
  - 1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.
  - 2. One wet-film thickness gauge.
  - 3. One dry-film thickness gauge, Mikrotest III, 0-40 mils with calibration standard approved by the Bureau of Standards.
  - 4. One Bacharach Sling Psychrometer, Model 12-7011.
  - 5. Tinker and Razor Model M-1 Holiday Detector and recommended wetting agent.
  - 6. One set of SSPC-VIS 1-89 Visual Standards for Abrasive Blast Cleaned Steel.
- B. Provide access via scaffolding or staging for inspection.
- C. Entire surface of coated submerged concrete shall be tested with holiday detector. Mark and repair all pinholes, then retest until no pinholes are found.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.
- B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.
- C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

## 1.07 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.
- B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open-flame heaters shall not be used.
- C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

## 1.08 COLOR SELECTIONS

- A. Provide color charts for all coatings being used on the project. After initial selection of colors by OWNER, provide draw down samples of selected colors for OWNER's final approval. For stained wood, provide specified wood species sample with selected color for final approval.
- B. CONTRACTOR shall provide a summary sheet at the completion of the project listing the finish paint products used and the manufacturer's color identification for each item painted. This summary sheet should be submitted to ENGINEER and OWNER for review.

## PART 2-PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin Williams Company, International Devco, Carbolite, PPG Protective and Marine Coatings, or equal, unless noted otherwise in the schedule.
- B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.
- C. Paint and paint products of Tnemec Company and Sherwin Williams, listed in the following specifications, are set up as standard of quality. International Devco, Carbolite, and PPG Protective and Marine Coatings have preapproved equivalent products that shall be used. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM Specifications shall be the latest revision:
  - 1. Abrasion—ASTM D4060, CS-17 Wheel, 1,000 grams load.
  - 2. Adhesion—ASTM D4541.
  - 3. Hardness—ASTM D3363.
  - 4. Humidity—ASTM D2247 and D4585.
  - 5. Salt (Fog) Spray—ASTM B117.

## PART 3-EXECUTION

### 3.01 SURFACE PREPARATION

#### A. General:

1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
2. No field painting shall be done before the prepared surfaces are observed by ENGINEER. Surfaces painted without such observation shall be abrasive-blast-cleaned and repainted.
3. Prior to field-blasting, a sample of the blast abrasive shall be provided to ENGINEER for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to ENGINEER for pH testing.
4. For on-site abrasive-blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Stauroilite abrasive shall be used on concrete and concrete block.
5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.
6. All concrete surfaces shall be tested for moisture in accordance with ASTM D4263 and, if necessary, F1869. Surfaces shall also be verified that the pH of the cleaned concrete surface to be coated is within the range of 8 to 11.

#### B. Ferrous Metal:

1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
2. All ferrous metals not primed in the shop shall be abrasive-blasted in the field prior to application of the primer, pretreatment, or paint.
3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive-blasting operations.
5. Ductile iron pipe shall be prepared by abrasive blasting per National Association of Pipe Fabricators NAPF 500-03-04 Abrasive Blast Cleaning.
6. Existing motors, pumps, and piping which are to remain shall be power tool cleaned to remove all existing coatings as specified in SSPC-SP15 Commercial Grade Power Tool Cleaning or NAPF 500-03-03 Power Tool Cleaning.
7. Existing ferrous metal materials which are impractical to abrasive-blast onsite and impractical to remove from the site shall be power-tool cleaned to bare metal as specified in SSPC-SP15 Commercial Grade Power Tool Cleaning or NAPF 500-03-03 Power Tool Cleaning.
8. Existing railings, stairs, and hoist rails shall be prepared by removing loose paint and rust per SSPC-SP11 power tool cleaning to bare metal. Mechanically abrade remainder of surfaces to roughen existing coatings. Clean per SSPC-SP1 Solvent Cleaning.
9. Other existing ferrous metal items in nonimmersion conditions to be painted shall be abrasive blasted to remove all existing coatings in accordance with SSPC-SP-6 Commercial Blast Cleaning or NAPF 500-03-04 Abrasive Blast Cleaning.

10. Existing ferrous metal in immersion conditions to be painted shall be abrasive blasted to remove all existing coatings in accordance with SSPC-SP10 Near White Blast Cleaning or NAPF 500-03-04 Abrasive Blast Cleaning.
  11. Prior to finish coating, all primed areas that are damaged shall be cleaned and spot-primed.
- C. Concrete:
1. All concrete surfaces, including precast concrete to be painted, shall be cleaned of all form oil, curing compound, and other foreign matter. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues.
  2. Bug holes, pits, voids, and cracks shall be filled as specified in Section 03 30 00—Cast-in-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
  3. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
  4. After cleaning, the surface shall be washed and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.
- D. Existing Concrete and Concrete Block:
1. All walls and ceilings of concrete and concrete block of existing structures, except as noted, shall be pole-sanded and hand-sanded to remove all old peeling paints as well as roughen-up existing paints.
  2. All precast concrete ceilings which are not currently painted but are scheduled for painting shall be abrasive-blasted in accordance with SSPC-SP13/NACE No. 6. Abrasive blasting of concrete shall result in a texture similar to 40-60 grit sandpaper (ICRI SP3-5).
  3. Bug holes, pits, voids, and cracks that are opened up shall be filled with an appropriate filler.
  4. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
  5. After cleaning, the surface shall be washed, and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.
- E. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with nonhydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC-SP1 and shall be abrasive-blasted in accordance with SSPC-SP16 Brush-Off Blast Cleaning.
- F. Copper: Where copper piping is not submerged or buried, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- G. PVC and CPVC: All PVC and CPVC to be painted shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- H. Aluminum: Where listed in the Schedule to be painted, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- I. Dust Controls:
1. All motors, pumps, mechanical equipment, and electrical controls shall be wrapped in 6 mil opaque plastic sheeting and taped in place with 3-inch-wide tape where abrasive blasting or spray coating application is being performed.



2. Plastic sheeting shall be provided with continuous filtered clean air supply to create a positive pressure relative to surrounding spaces.

### 3.02 APPLICATION

- A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.
- B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.
- C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.
- D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.
- E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.
- F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.
- G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.
- H. Walls and ceiling surfaces shall receive a minimum of one coat of paint before surface-mounted items such as conduits, boxes, piping, etc., are installed on these surfaces.
- I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to, between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.
- J. No paint shall be applied to new or existing surfaces until joints have been caulked according to Section 07 90 00 requirements, except at moving joints which shall be finish-painted before caulking or caulking shall be protected during painting.
- K. For PVC and CPVC piping, unions and valves shall not be painted.

### 3.03 FIELD QUALITY CONTROL

- A. Examination of work on the site by the manufacturer's representative shall be performed when requested by ENGINEER.

### 3.04 CLEANING

- A. All stains and marks shall be removed from other surfaces upon completion of the work.

### 3.05 SCHEDULE

#### A. General:

1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched-up.
2. See Finish Schedule on the drawings for an additional reference for areas to be painted.
3. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze, machined surfaces, moving parts where painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask engineer.
4. Products listed first are Tnemec and second are Sherwin Williams.

#### B. New Work:

1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all non-galvanized ferrous metal items scheduled for painting be shop-primed. If items are not shop-coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from ENGINEER, and the items shall be painted as part of this Contract without additional cost.
2. Interior concrete floors, including equipment bases: One prime coat of 201 Epoxoprime, ArmorSeal 1000 HS Epoxy (reduced), hand broadcast antiskid sand into the wet paint between finish coats in locations as requested by OWNER, and two finish coats of 280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy.
3. Interior concrete block walls: One filler coat of Epoxoblock WB 1254, Kem Cati-Coat HS, and two coats Series 66HS Hi-Build Epoxoline, Macropoxy 646.

Note: Paint shall be roller- or brush-applied to concrete sound-absorptive block.

4. All exposed precast concrete ceilings two coats of Series 66HS Hi-Build Epoxoline, Macropoxy 646.
5. Cast or ductile iron; not submerged or buried (including pipes to be insulated):
  - a. One shop coat of 66HS-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
  - b. Touch-up prime coat prior to finish coating; and apply either:
    - (1) Two coats of 66HS Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces, or
    - (2) One coat of 66HS Hi-Build Epoxoline II, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
6. Cast or ductile iron, tar coated; buried: Not painted.
7. Cast or ductile iron, submerged:
  - a. One shop coat Series 1 Omnithane (20HS or 66HS-1255 Epoxoline), Dura-Plate 235 Beige as primer.
  - b. Touch-up prime coat prior to finish coating and one stripe coat on all edges of 66HS Epoxoline, Dura-Plate 235.
  - c. Two coats of Series 66HS-Hi-Build Epoxoline II, (one coat) Sher-Glass FF.
8. Steel, machinery, and equipment; not submerged (including pipes to be insulated):
  - a. One shop coat of 66HS-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer.
  - b. Touch-up primer prior to finish coat, and either:
    - (1) Two coats of 66HS Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
    - (2) One coat of 66HS Hi-Build Epoxoline II, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

FIRST FIELD COAT SHALL BE APPLIED PRIOR TO INSTALLATION TO SURFACES INACCESSIBLE AFTER INSTALLATION INCLUDING BACK SIDES OF DOOR FRAMES. SEE DIVISION 08 FOR FACTORY-APPLIED DOOR PRIMERS.

9. Motors, gear drives, and doors delivered with nonepoxy primers:
    - a. Degrease per SSPC-SP1.
    - b. Lightly hand-sand per SSPC-SP2.
    - c. Apply one coat 135-1255 Chembuild Beige, Macropoxy 646 Beige.
    - d. Apply two finish coats as follows:
      - (1) Two coats of 66HS Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces, or
      - (2) One coat of 66HS Hi-Build Epoxoline II, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
  10. Steel, machinery, and equipment, submerged:
    - a. One shop coat Series 1 Omnithane (20HS or 66HS-1255 Epoxoline), Dura-Plate 235 Beige as primer.
    - b. Touch-up prime coat prior to finish coating, and one stripe coat on all edges of 66HS Hi-Build Epoxoline, Dura-Plate 235.
    - c. Two coats of 66HS H-Build Epoxoline, (one coat) Sher-Glass FF.
  11. Galvanized, copper, brass, CPVC, and PVC; not submerged or buried:
    - a. One coat of 66HS-1255 Hi-Build Epoxoline II, Macropoxy 646, and either:
    - b. Two coats of 66HS Hi-Build Epoxoline, Macropoxy 646 for interior surfaces, or
    - c. One coat of 66HS Hi-Build Epoxoline, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
  12. Insulation of equipment, pipes, and ductwork:
    - a. Two coats of Series 1029 Endurotone, DTM Acrylic B66100.
    - b. Colored PVC jacketing shall not be painted.
  13. Galvanized, copper, CPVC, and PVC; submerged or buried: Not painted.
  14. Aluminum items:
    - a. Exposed areas of structural items such as railings and grating shall not be painted.
    - b. For structural items in contact with concrete, See Division 05.
  15. Stainless steel: Not painted.
- C. Existing Areas: Existing areas damaged by removal of existing work and/or installation of new work shall be repainted to match existing and in accordance with the schedule for new work. Existing equipment and structures shall be painted in accordance with the following schedule and as listed in the Finish Schedule, or as noted on the drawings.
1. PVC and plastic piping:
    - a. Hand sand.
    - b. Solvent clean.
    - c. Coat in accordance with item 12 of new work.
  2. Ductile iron piping:
    - a. Remove existing coating and prepare as specified.
    - b. Coat in accordance with items 5 or 7 of new work with shop primer replaced by field primer.
  3. Steel handrails, stairs-interior, monorails, lintels, etc.:
    - a. Prepare as specified.
    - b. Prime and coat per new item 8.
  4. Precast and cast-in-place concrete and concrete block walls, ceilings, and floors which are currently unfinished.
    - a. Prepare as specified.
    - b. Coat per new items 2, 3, or 4.

5. Interior concrete block walls which are currently painted and remain exposed:
  - a. Prepare and coat as specified.
  - b. Provide spot masonry filler coat as needed and two finish coats per Item 3 of new work.
6. Insulation of Equipment and Pipes: Prepare and coat per new item 13.

D. Coverage:

1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of ENGINEER, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.
3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the painter, one additional coat, minimum, will be required to achieve total DFT thickness as specified and recommended by the manufacturer.

	Sq. Ft.** Coverage	Dry Mil** Thickness Per Coat
<b>Products</b>		
1029 Endurotone, DTM Acrylic B66100	200	
66HS Hi-Build Epoxoline II, Macropoxy 646		
Steel or Impervious Substrate Primer Coat	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish coat	---	5.0
135-1255 Chembuild, Macropoxy 646	335	4.0
Steel Doors	---	3.0
20HS Pota-Pox, Macropoxy 646 NSF		
Steel or Impervious Substrate Primer	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish Coat	---	5.0
1074 Endura-Shield II, Acrolon 218HS	---	2.5
Epoxoblock WB 1254, Kem Cati-Coat HS	80	
66HS Hi-Build Epoxoline, Macropoxy 646 (Masonry and Concrete)	250	
Series1 Omnithane, DuraPlate 235 (Primer)		3.0, 5.0
66HS HI-Build Epoxoline (Submerged)		6.0
Sher-Glass FF (Submerged)		12.0

\*\* Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or application. Final total dry film thickness (DFT) shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to promote coverage.

E. Pipe Colors:

1. Colors are to be selected by OWNER, with the following colors used where applicable. Pipe color shall be in accordance with the requirements of the Wisconsin Administrative Code.

Pipe Type	WASTEWATER PIPING COLORS	
	WI DNR NR 110	10 States Standards (2014 Wastewater)
Natural gas	Orange	Red
Potable water	Blue	Blue
Sewage (wastewater)	Gray	Gray
Compressed air	Green	Dark Green
Fuel oil	-	Red
Plumbing drains and vents	-	Black
Nonpotable water	Blue with 6-inch red band spaced 30 inches apart	Purple
Electrical Conduit	-	-

<sup>1</sup> Section 653.120 Piping Identification:

- a) Piping in a water treatment facility shall be identified clearly by legends and color coding as described in the Standards or American National Standards Institute (ANSI) Standard A-13.1. A consistent standard shall be used throughout the system.
- b) Potable water lines shall be clearly and permanently identified where dual water lines or pressure sewer systems exist.

2. See Madison Metropolitan Sewerage District color selections at the end of this section for further guidance on color selections.

F. Shop Finish Painting: The following items shall have factory-applied finishes and will not require field painting. CONTRACTOR shall field touch-up any damaged areas with factory-provided touch-up coating.

1. Sectional overhead doors and overhead coiling doors.
2. Fiberglass doors.
3. Hoists, trolleys, and cranes.
4. Factory-finished HVAC equipment. Rooftop units are to be field-painted.
5. Motor control centers.
6. Supervisory control centers.
7. Switchgear.
8. Sump pumps.

END OF SECTION

**MADISON METROPOLITAN SEWERAGE DISTRICT  
PUMP STATION  
COLOR SELECTIONS**

**PIPING (All Stations) Dry Conditions**

Air/Bubbler	=	Plum: SW4080
Drain/Waste/Vent	=	Cedar Green SW4072
Potable Water (Hot & Cold)	=	Safety Blue (insulated) SW4086
Non-Potable Water	=	Light Blue (insulated) NSF3
Seal Water	=	Light Blue (insulated) NSF3
Roof Drain	=	Cedar Green (insulated) SW4072
Natural gas	=	Safety Yellow: SW4084
Refrigerant	=	Insulated with Arm-a-Flex (NOT painted)
Raw Wastewater (valves, forcemains, etc.)	=	Haze Gray

**MECHANICAL (All Stations)**

Pumps & Pumps Bases	=	Haze Gray:
Pump Motors	=	Haze Gray:
Pipe Supports (columns, knee braces, etc.)	=	Haze Gray:
Sluice Gate Floor Stands	=	Haze Gray:
Concrete Pump Pads	=	Unpainted concrete (NOT painted)
Equipment Pad Edges	=	Unpainted concrete (NOT painted)

**HVAC (All Stations)**

Non-insulated Ductwork	=	Mill finish (aluminum/galvanized – NOT painted)
Insulated Ductwork	=	NOT painted
Air Handling Units	=	Factory finish (grayish) – NOT painted in the field
Gas Fired Unit Heaters	=	Factory finish (grayish) – NOT painted in the field
Registers & Grilles	=	Factory finish (white) – NOT painted in the field
Ventilators & Fans	=	Mill finish from factory (aluminum) – NOT painted

**STRUCTURAL/ARCHITECTURAL (All Stations)**

Interior Block Walls	=	Mill Ivory: SW4036
Interior Ceilings	=	Mill Ivory: SW4036
Interior Beams and Structural Supports	=	Mill Ivory: SW4036
Interior Hoist Rail & Supports	=	Safety Yellow: SW4084
Miscellaneous Metals (lintels, etc.)	=	SW: Bronzetone (same color as doors)
Floor Doors & Checker Plate	=	Mill finish from factory (aluminum) – NOT painted
Stair Stringers, Handrails, etc.	=	Rain Forest Green: SW4071
Stair Risers	=	Safety Yellow: SW4084

**ELECTRICAL (All Stations)**

Conduit	=	not painted
Cabinets (switchgear, MCC, etc.)	=	Factory finish (grayish) – NOT painted in the field

**GENERAL (All Stations)**

Hollow Metal Doors	=	SW: Bronzetone
Hollow Metal Door Frames	=	SW: Bronzetone
Existing OHD, Jambs & Corner Guards	=	SW: Bronzetone
New Overhead Coiling Door	=	SW: Bronzetone – By Manufacturer – NOT painted
HVAC Louvers	=	SW: Bronzetone – By Manufacturer – NOT painted
Interior Concrete Walls	=	Mill Ivory: SW4036
Transom Panel(s)	=	SW: Bronzetone (same color as doors)

**Colors Used:** Plum SW4080, Cedar Green SW4072, Rain Forest Green SW4071, Safety Blue SW4086, Light Blue NSF3, Bronzetone, Haze Gray, Safety Yellow SW4084, Mill Ivory SW4036

# SHERWIN WILLIAMS COLOR GUIDE CHART 2009

COLORS ARE NOT EXACT MATCHES

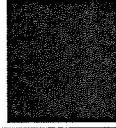
**Obstinate Orange**



**CEDAR GREEN**



**SAFTEY BLUE**



**HAZE GRAY**



<b>SW 6884</b> – Hot Water Systems	<b>SW 407</b> – Drain/Waste/Vent/ Roof Vent, Can stations exterior	<b>SW4086</b> – Potable Water (Hot & Cold)	Raw Wastewater (valves, forcemains, etc.). Pumps & Motors, Pumps Bases, Sluice Gate Floor Stands. There is no number for Haze Gray
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**RAIN FOREST**



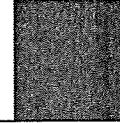
**LIGHT BLUE**



**ANSI #70 Gray**

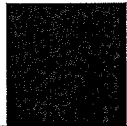


**PLUMB**



<b>SW4071</b> Stair Stringers, Handrails,	<b>NSF3</b> - Non-Potable Water/ Seal Water, pipe and hydrants /with 6 inch band every 30 inches	<b>ANSI #70 GRAY</b>  Not used	<b>SW4080</b> - Air/Bubbler, DAF Air lines
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**BRONZETONE**



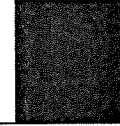
**SAFTEY YELLOW**



**MILL IVORY**



**SAFTEY RED**



<b>BRONZETONE</b> - Miscellaneous Metals (lintels, etc.)Hollow Metal Doors, Frames, Existing OHD, Jambs & Corner Guards, New Overhead Coiling Door, HVAC Louvers, Transom Panel, RFB Doors	<b>SW 4084</b> - Natural gas, Stair Risers, Interior Hoist Rail & Supports,	<b>SW 4036</b> - Interior Block or drywall walls, Interior Ceilings, Interior Beams, Structural Supports, Conduit	<b>SW 4081</b> – Fire Hydrants, Digester Gas
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Updated 6feb2014 jk

SECTION 09 97 23

WET WELL LINING SYSTEM

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: Surface preparation and application of wet well lining system on walls and ceilings as noted on drawings.

1.02 DEFINITIONS

- A. DFT: Dry Film Thickness.

1.03 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01 33 00-Submittals and Operation and Maintenance manuals under Section 01 33 00-Submittals.
- B. Provide product information and schedule of system and thicknesses. Include only two copies of the Material Safety Data Sheet (OSHA Communication Standard).

1.04 PREINSTALLATION MEETING

- A. CONTRACTOR shall convene a meeting with ENGINEER, applicator, and material supplier to discuss approved application products, finishes, and curing methods.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in the manufacture of industrial-grade coatings with a minimum of 15 years of documentable satisfactory experience.
- B. Applicator: Product manufacturer shall provide written certification that applicator has been trained in the application of the product. Applicator shall have a minimum of 5 years of satisfactory documented experience in the business of similar coating applications and project size.
- C. Single Source: Except as noted, furnish field primers, pretreatments, and thinners by the same manufacturer as finish coats.
- D. Prepare and finish sample surfaces for observation by ENGINEER to establish acceptable standards for the work.

1.06 ENVIRONMENTAL CONDITIONS

- A. Do not apply coating unless surface and surrounding air temperatures are above 50°F. Concrete surface temperature must be decreasing during time of application.
- B. Do not apply product in cold, foggy, damp, or rainy weather.



## 1.07 WARRANTY

- A. CONTRACTOR shall provide manufacturer's standard system warranty.
- B. Correction Period: 5 years.

## PART 2-PRODUCTS

### 2.01 APPROVED MANUFACTURERS

- A. Sauereisen, 160 Gamma Drive, Pittsburg, Pennsylvania 15238-2989, fax (412) 963-7620, [www.sauereisen.com](http://www.sauereisen.com).
- B. Tnemec Company, Inc., 6800 Corporate Drive, Kansas City, Missouri 64120-1372, (800) TNE MEC1 [(800) 863-6321], [www.tnemec.com](http://www.tnemec.com).
- C. Sherwin Williams Company, [www.sherwin-williams.com](http://www.sherwin-williams.com).
- D. Epoxytec Intl, Inc., 3000 N 29 CT, Hollywood, Florida 33020, 1 (800)-463-7699, [ww.epoxytec.com](http://ww.epoxytec.com).

### 2.02 APPROVED SYSTEMS

- A. Sauereisen:
  - 1. Filler Compound No. 209.
  - 2. SewerGard No. 210S.
- B. Tnemec Company, Inc.
  - 1. Series 218 Mortarclad resurfacer.
  - 2. Series 436 Perma-Shield F.R.
- C. Sherwin Williams System.
  - 1. Duraplate 2300 Waterbased Epoxy Cementitious Resurfacer.
  - 2. Duraplate 5800 High Build Epoxy.
- D. Epoxytec Intl, Inc.:
  - 1. Mortartec Ceramico RCME1 resurfacer.
  - 2. Epoxytec CPP Sprayable."

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Provide dry heat and ventilation as needed to obtain the recommended drying conditions.
- B. Starting of work shall be construed as acceptance of surfaces and conditions by the applicator.
- C. Do not apply product to improperly prepared, wet, or damp surfaces.

- D. Material shall not be applied when surfaces are subjected to direct sunlight or when air and surface temperatures are rising.
- E. Correct deficiencies in the total film by applying additional coats and in accordance with manufacturer recommendations.

### 3.02 FIELD QUALITY CONTROL

- A. Provide high-low thermometers to verify temperatures and any other instrumentation needed to verify that ambient surface and material conditions are within the recommended application parameters.
- B. Thickness:
  - 1. During application, a wet film thickness gauge meeting ASTM D4414–Standard Practice for Measurement of Wet Film Thickness of Organic Coating by Notched Gauges, shall be used to provide a monolithic coating and uniform thickness during application.
  - 2. Compute gallons required to each coat prior to application based on the square footage to be coated.

### 3.03 SURFACE PREPARATION

- A. General:
  - 1. Examine all surfaces to be coated and the conditions affecting proper performance.
  - 2. Correct unsatisfactory conditions.
  - 3. Perform preparation and cleaning procedures in accordance with manufacturer instructions to obtain a clean and dry surface.
- B. Concrete Surfaces: Formed, Trowel Finish, or Flatwork:
  - 1. Allow concrete to cure a minimum of 28 days:
    - a. Verify dryness by performing ASTM D4263 “Plastic Film Tape-Down Test.”
    - b. Surfaces where the opposite side is exposed to earth shall be tested by performing ASTM F1869 “Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.” Moisture shall not exceed 3 pounds per 1,000 square feet in a 24-hour period.
  - 2. pH Testing:
    - a. Check pH of the concrete surface to verify it is between 10.0 and 13.0.
    - b. Check pH a minimum of once for every 1,000 square feet of surface area, with no two tests closer than 50 feet apart.
  - 3. Moisture Testing:
    - a. Verify dryness by testing for moisture with an ASTM D 4263 “plastic film tape-down test.”
    - b. Verify dryness a minimum of once for each of each structure.
  - 4. Moisture Vapor Transmission Testing: Verify the moisture vapor transmission is less than 3 pounds per 1,000 square feet in a 24-hour period by the ASTM F1869 “Standard test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.”

5. Prepare surfaces by abrasive blasting according to SSPC-SP 13.
  - a. Walls shall have large burrs, fins, and form irregularities ground uniformly prior to other preparation.
  - b. Abrasive-blast horizontal surfaces to remove laitance, curing compounds, sealers, or other contaminants. The surface shall expose the fine aggregate resembling 60-grit coarse sandpaper.
  - c. Abrasive-blast vertical surfaces to open bug holes and remove laitance, form release agents, curing compounds, or other contaminants. The surface shall expose the fine aggregate resembling coarse sandpaper.
6. Allow concrete to cure a minimum of 28 days.
  - a. Verify dryness by performing ASTM D4263 "Plastic Film Tape-Down Test."
  - b. Surfaces where the opposite side is exposed to earth shall be tested by performing ASTM F1869 "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride." Moisture shall not exceed three pounds per 1,000 square feet in a 24-hour period.

### 3.04 APPLICATION

- A. No application shall be performed until all substrate preparation and testing is complete for the structure being coated.
- B. Spray apply the first coat only to areas that can be final coated within the manufacturer's recoat window. If the recoat window is exceeded, the surface shall be prepared according to the manufacturer's recommendations and recoated. Contact the manufacturers for information and times in addition to that provided in their literature.
  1. Sauereisen system:
    - a. Fill bug holes and irregularities with 209.
    - b. Sauereisen does not recommend a primer with 210S.
    - c. Spray apply one or two coats of 210S at a minimum 100 mils total to concrete fillet, walls and ceilings.
    - d. Comply with all manufacturer's temperature requirements for material and substrate.
  2. Tnemec system:
    - a. Fill bugholes and irregularities with 218.
    - b. Spray apply one or two coats of 436 at a minimum 100 mils to concrete fillet, walls, and ceilings.
  3. Sherwin Williams system:
    - a. Fill bug holes and irregularities with 2300.
    - b. Primer as required by manufacturer.
    - c. Spray apply one or two coats of 5800 at minimum 100 total mils to concrete fillet, walls, and ceilings.
  4. Epoxytec System:
    - a. Fill bug holes and irregularities with RCME1 resurfacer.
    - b. Primer as required by manufacturer.
    - c. Spray apply one or two coats of CPP Sprayable at a minimum 100 total mils to concrete fillet, walls, and ceilings.
- C. Finish coats shall be applied at a minimum 30 square feet per gallon (50 mils) each coat. Spray apply the first coat only to areas that can be final coated within the manufacturer's recoat window. If the recoat window is exceeded, the surface shall be prepared according to the manufacturer's recommendations and recoated. Contact the manufacturers for information and times in addition to that provided in their literature.

1. The Sauereisen data sheet lists the recoat window between 4 and 24 hours at 70° Fahrenheit.
2. The Tnemec data sheet lists the recoat windows to be a minimum of 8 to 24 hours to recoat within seven days to maximum recoat at 75°Fahrenheit and 10 to 24 hours to recoat within seven days to maximum recoat at 55°Fahrenheit.

### 3.05 PROTECTION OF OTHER WORK

- A. Protect adjacent surfaces including floors, equipment, or refinished materials by covering with drop cloths or other acceptable means.
- B. Maintain safe conditions at all times. Remove solvent-soaked rags and other flammables daily from the area or keep in airtight metal containers.

### 3.06 INSPECTION AND ACCEPTANCE

- A. Immediately repair improperly prepared surfaces, misapplied materials, or inferior workmanship.
- B. Touch up or reapply product to surfaces which have been damaged.
- C. Holiday Inspection:
  1. After the protective coating has set hard to the touch, it shall be inspected with high-voltage holiday detection equipment. Surfaces shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99).
  2. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper marked or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touchup/repair procedures shall follow the protective coating manufacturer's recommendations.
- D. Costs of specified tests shall be paid by CONTRACTOR.
- E. Costs for any reinspection or retesting due to defective workmanship or materials shall be paid by CONTRACTOR.

### 3.07 CLEANING

- A. Clean all splattered surfaces by methods which will not scratch, mar, or otherwise cause damage to finishes.

END OF SECTION

SECTION 10 14 00  
PLASTIC AND METAL SIGNS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Caution signs.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, and overall dimensions of each sign.

PART 2–PRODUCTS

2.01 DANGER SIGNS

- A. CONTRACTOR shall provide danger signs complying with OSHA requirements. Signs shall state Danger–Permit Required Confined Space Do Not Enter.
- B. Signs shall be fiberglass, Brady Systems, or equal, minimum size 7 inches by 10 inches. Colors shall be red and black on white.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer’s instructions.
- B. Install signs after surfaces are finished in locations as shown on the drawings.

3.02 SCHEDULES

- A. Provide CAUTION signs at wet well. Provide one total.

END OF SECTION

## SECTION 12 48 43

### FLOOR MATS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Switchboard mats.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

#### PART 2—PRODUCTS

##### 2.01 DIAMOND-PLATE SWITCHBOARD MATS

- A. Switchboard mats shall be diamond-plate, high-performance, nonconductive, switchboard matting. Matting shall conform to ANSI/ASTM D-178-01, Type II, Class 2.
- B. Acceptable manufacturers shall include the following, or equal: Wearwell Carpet, No. 701. Mats shall be 3 feet wide and extend the full length of the equipment.

#### PART 3—EXECUTION

##### 3.01 INSTALLATION

- A. Install mats after cleaning of finish flooring.
- B. Provide mats for the lighting panel, SCS, automatic transfer switch, level sensing bubbler control panel, and any other free-standing or pad-mounted electrical equipment.

END OF SECTION

## SECTION 13 12 00

### PREFABRICATED CONTROL BUILDING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work included: Providing and installing one pre-engineered Control Building comprised of an insulated modular steel building installed on a prefabricated steel base and includes all necessary electrical, heating, and ventilation controls and accessories as shown on the drawings and specified below.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. The intent of these specifications and drawings is to establish a quality and performance level for structural design, material, durability and workmanship.
- D. All Bidders must conform strictly to these specifications in their bid.
- E. The building shall be the design of a manufacturer who is regularly engaged in the fabrication of pre-engineered structures. All materials shall be new, unused, free from defects, and of American manufacture.

##### 1.02 DESIGN LOADS

- A. The building design shall be in accordance with the Wisconsin Enrolled Commercial Building Code. All design loads shall be determined in accordance with the Wisconsin Enrolled Commercial Building Code and shall be listed on the manufacturer's building drawings.

##### 1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. Product Data: Provide data on design loads; building and component dimensions; general construction details; fasteners, anchorages, and method of anchorage; wall and roof panels; and trusses and roofing components, doors, and prefabricated base.
- C. Shop Drawings: A complete set of drawings shall be supplied providing installation and operation instructions of the control system. The shop drawings shall include the following:
  - 1. Sufficient detail to evaluate compliance with these specifications.
  - 2. A detailed component list including manufacturer and catalog number.
  - 3. A custom-wiring diagram for this specific application to facilitate and provide accurate field connections to the control panel by electrical installation personnel.
  - 4. A description of the operation for the control panel.
  - 5. An enclosure dimension print.
  - 6. Provide an electrical one-line diagram indicating conduit and wire sizing, overcurrent protective device ratings, and short circuit current withstand/interrupting ratings.
  - 7. Provide detailed point-to-point wiring diagrams for HVAC controls in CAD format.

8. Provide additional information where specified to be provided in equipment specification sections referenced herein.
- D. Certification: Submit complete structural design computations bearing the seal of a professional engineer licensed in the State of Wisconsin.

## PART 2-PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURER

- A. The products of the following manufacturers, or equal, are acceptable, provided that they comply with the remainder of this specification: Power Shack by USEMCO, Inc., Tomah, Wisconsin.
- B. These products are set up as a standard of quality. Other manufacturer's products will be accepted if they are equal in quality.

### 2.02 MATERIALS

- A. The principal items of equipment shall include, but not be limited to, the following: modular building, a prefabricated steel base, environmental controls, convenience accessories, panelboards, surge protective device, lighting and controls, receptacles, door partition switches, and HVAC equipment and controls.
- B. Prefabricated Base:
  1. The prefabricated base shall be a minimum 3/8-inch structural grade steel plate, reinforced with adequate sized steel channels to prevent deflection due to equipment weight and stresses imposed from lifting and setting of equipment.
  2. Bolt on lifting eyes shall be placed about the perimeter of the equipment base to facilitate lifting and handling of the station. The lifting eyes shall be easily removable after the station has been set in place.
  3. The steel plate and structural members shall meet or exceed the requirement of ASTM A36.
- C. Modular Building:
  1. The control building will be complete with a factory assembled modular building affixed to the steel equipment base. The completed structure shall be one piece when delivered and require only off loading, installation on the existing foundation slab, process pipe hook up, and electrical service to complete the installation. Field erected buildings will not be acceptable.
  2. All sidewall and ceiling panels shall consist of interior and exterior metal skins formed with steel dies and roll-forming equipment and checked with gauges for uniformity and accuracy. Polyurethane shall be foamed-in-place (poured, not frothed) and, when completely heat-cured, shall bond to the metal skins to form a rigid 4-inch thick insulated panel. Overall coefficient of heat transfer ("U" factor) shall be a minimum of .033 (R-30) for 4-inch thick walls. Panels shall contain 100% polyurethane insulation and have no internal wood between the skins. Panel edges shall have foamed-in-place tongues and groove joints with a flexible vinyl gasket foamed-in-place on the interior and exterior of all tongue edges.
  3. The polyurethane foam core shall be classified by Underwriters Laboratories with a flame spread of 25 or lower and smoke generation of less than 450 when tested in accordance with UL Standard 723 (ASTM Standard E-84).



4. Panels shall be equipped with cam lock joining devices. Each locking device shall consist of a cam-action, hooked locking arm placed in one panel, and a steel rod positioned in the adjoining panel, so that when the locking arm is rotated, the hook engages over the rod and draws the panel tightly together with cam action. The locking arms and steel rods shall be housed in individual steel pockets set into the panel. Pockets on one side of the panel shall be connected to pockets on the other side, in width, by the use of steel straps set into the insulation. Press fit caps shall be provided to close lock wrench holes. A cam lock wrench shall be supplied with the building. Wood reinforcement shall be placed inside the wall and ceiling panels where required to support the station equipment loads. Wood reinforcement in a wall and ceiling panel shall be totally enclosed within the panel and clad with the exterior and or interior metal skins. Refer to the Drawings for locations of Division 26-provided equipment being field mounted on building walls and provide additional structural supports in walls where required to accommodate structural loadings.
  5. Exterior of building shall be a minimum of .024-inch (24 gauge) thick galvanized steel panel.
  6. Interior of building shall be a minimum of .024-inch (24 gauge) thick galvanized steel panel, protected by a spray and baked white color polyester protective coating.
  7. Building shall have one hinged entrance door insulated with full 2-inch-thick foam polyurethane insulation core. Matching metal jambs shall be furnished to fit prefabricated panels without the use of any interior framing. Jamb members shall attach to panels with sheet metal screws. The door shall be supplied with weather stripping and wiper gasket. The door shall be a single-entry door with a minimum 80-inch by 36-inch clear opening size.
  8. Door hardware shall be cylindrical lockset with satin stainless steel finish with three tamper-proof pinned butt hinges.
  9. All exterior doors shall be supplied with a metal shield above the door to divert rain and snow from the door opening.
  10. Provide an extruded aluminum sill plate for exterior doors.
- D. Lifting Device: A spreader bar type lifting device, built to lift the modular building from each corner of deck structure without impinging the lifting chain/cables on the modular building sidewalls, shall be provided by the installing CONTRACTOR.
- E. Welding:
1. Welding shall be in accordance with standard AWS practices, with proper fillet section and continuity to provide a sound, watertight structure.
  2. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across the weld not less than that of the thinner of the connected sections, and shall be watertight.
  3. All welds in contact with soil or water shall be tested with dye penetrant to review the watertight integrity of the weld system.
- F. Painting:
1. All mill scale, rust, weld flux and other foreign matter shall be removed from all steel surfaces by shot blasting to SSPC SP-10 specification for near-white blast cleaning. Surface irregularities shall be removed by grinding.
  2. Interior surfaces shall receive two coats of hi-build epoxy coating. The coating materials shall show excellent resistance to splash or spillage of water, petroleum products or salt solutions. The interior coatings shall be applied to 3 mils dry film thickness each coat.
  3. A paint touch-up kit shall be provided with the station for coating field weld joints and damaged areas.

4. The floor in all working areas within the station shall be protected with heavy dielectric neoprene matting.
- G. Siding: The building exterior shall be covered with a factory fabricated veneer panel with an exterior face in a running bond pattern of kiln-fired clay brick finish applied with a polymer epoxy resin on a mineral fiber reinforced cement board. The panels shall be attached to wood reinforcement panels that are embedded in the building panels. The panels shall be warranted to be free from defective material or workmanship for 5 years. Acceptable products are BrickWal by Fullerton Finish Systems, or equal. The color shall be selected by OWNER.
- H. Roof:
1. The roof shall consist of a pitched truss roof with a 6:12 minimum pitch with 12 inches overhang on all sides. Roof peak is to run parallel to the station longest dimension. Mounting strips to be installed in modular building for mounting of the roof trusses.
  2. Roof construction shall consist of wood truss with maximum spacing of 24-inch on-center covered with exterior grade plywood, 30# underlayment, and standing seam steel sheets. The standing seam sheets shall have a factory applied Kynar 500 coating. The color shall be selected by OWNER.
  3. The roof construction shall include aluminum soffit and fascia.
- I. Ventilation: The building shall be provided with ventilation equipment as indicated on the drawings and as specified in Division 23.
- J. Heater: The building shall be provided with heating equipment as indicated on the drawings and as specified in Division 23.
- K. Electrical:
1. Lighting:
    - a. The control building shall include two interior Vaportite LED light fixtures as manufactured by Metalux Model 4VT2-LD5-DR-UNV-L835-CD1-U, or equal, located where shown on the Drawings.
    - b. The control building shall include three exterior light fixtures, as manufactured by Cree Model XSPW-A-0-3-F-G-U-T, or equal, located where shown on the Drawings.
  2. Conduit: All conduit shall be provided as specified in Section 26 05 33–Conduit.
  3. Wiring, connectors, and terminal blocks: All wiring, connectors, and terminal blocks shall be provided as specified in Section 26 05 19–Wire.
  4. Switch, outlet, junction, and pull boxes and hinged-cover enclosures: All boxes and hinged-cover enclosures shall be provided as specified in Section 26 05 35–Boxes and Section 26 27 16–Hinged-Cover Enclosures.
  5. Wiring devices: The following devices shall be provided as specified in Section 26 27 26–Wiring Devices:
    - a. Wall switches.
    - b. Receptacles.
    - c. Cover plates.
    - d. Thermostats.
  6. Electrical equipment supports: Supports shall be provided as specified in Section 26 05 29–Supporting Devices.
  7. Electrical Identification: Identification for electrical equipment, boxes, wiring, and cables, etc. shall be provided as specified in Section 26 05 53–Electrical Identification.
  8. Surge protective device: Provide a surge protective device for the lighting panel as specified in Section 26 43 13–Surge Protective Devices.

9. Lighting Panel: The 120/208-volt lighting panel (LP-Thurber) shall be provided as specified in Section 26 24 16–Panelboards. Refer to the Drawings for the lighting panel schedule and the electrical one-line diagram.
10. Door position switches: Door position limit switches shall be provided as specified in Section 26 09 00–Controls and Instrumentation.
11. Execution/Controls:
  - a. All equipment provided under this Section shall be factory installed and pre-wired in accordance with Division 26. All equipment interfacing with Division 26-provided field wiring shall be prepared for field connections and clearly identified for its designated use.
  - b. Refer to the Drawings for locations of Division 26-provided equipment being field mounted on building walls and provide additional structural supports in walls where required to accommodate structural loadings.
  - c. The lighting panel (LP-Thurber) shall be surface mounted on the interior wall.
  - d. The door position switch shall be wired to an interior junction box for Division 26-provided field wiring from the SCS control panel to the door position switch wiring junction box.
  - e. Lighting Controls:
    - (1) A two-pole light switch shall be mounted on the interior latch side of the entrance door. One pole shall be used to control the interior upper level light fixtures and the other pole shall be used to control the exhaust fan as described below under HVAC Controls.
    - (2) Exterior light fixtures shall be controlled from the Section 26 09 00 System Supplier-furnished SCS control panel. All exterior light fixtures shall be factory pre-wired to an interior-mounted junction box for Division 26-provided field wiring from the lighting panel, through the SCS control panel, to the light fixture wiring junction box.
  - f. HVAC Controls:
    - (1) Electric wall heater: The wall heater shall be controlled by its integral thermostat.
    - (2) Exhaust fan and damper actuators:
      - (a) The exhaust fan shall be controlled by an interior thermostat and by the two-pole interior light switch.
      - (b) When the room temperature rises above the thermostat setpoint, the fan shall start and run continuously until the room temperature falls below the thermostat setpoint.
      - (c) When the interior light switch is turned on, the exhaust fan shall start and run continuously, bypassing the thermostat control, until the light switch is turned off, after which the fan shall continue to be controlled by the thermostat as described above.
      - (d) The exhaust fan intake-air damper actuator and gravity roof ventilator damper actuator shall both be powered open when the exhaust fan is running, and shall otherwise be closed.
12. Refer to the Drawings for specific equipment and work noted to be provided with the building specified herein. The following is a general list of major electrical equipment and work provided under other Divisions or by OWNER. This list is not all inclusive.
  - a. Standby power system, automatic transfer switch, and associated conduit and wiring.
  - b. Radio telemetry system and antenna tower.
  - c. All electrical work and equipment in the valve vault and wet well.
  - d. SCADA System SCS control panel (SCS-Thurber).
  - e. Pump starters and disconnect switches.

- f. Main service-entrance disconnect switch and utility meter socket.
- g. All field-installed conduit and wiring for equipment provided under this Section that is not factory pre-wired.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Metal building shall be furnished and erected by CONTRACTOR on the existing concrete slab in accordance with manufacturer's instructions.
- B. Building shall be securely anchored to the concrete slab according to manufacturer's design and details. All accessories necessary to provide a complete installation shall be furnished and installed by CONTRACTOR.

END OF SECTION

SECTION 22 00 01

PLUMBING

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. All material and piping for plumbing.
  - 2. Piping connections to all plumbing equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

PART 2-PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials shall be National Sanitation Foundation (NSF) approved.

2.02 PLUMBING PIPING AND APPURTENANCES

- A. Unless otherwise specified, piping and appurtenances shall be in accordance with Section 40 05 02-Piping and Appurtenances.

2.03 PLUMBING EQUIPMENT

- A. Sump Pumps:
  - 1. Manufacturers: Submersible sump pump(s) shall be manufactured by Hydromatic (H), Myers (M), PACO (P), Zoeller (Z), or equal. Furnish and install complete sump pump system(s) as shown on the drawings and specified herein. The complete system shall include pumps, electric controls, level controls, and all accessories.
  - 2. Schedule:

Pump No.	Model No.	Capacity (gpm)	TDH (ft)	Discharge Diameter	RPM	Voltage	Phase	HP	Location
--	SK50	30	20	2-inch	1750	115	1	0.5	--

- 3. Type: Submersible pumps shall be constructed of epoxy-coated cast iron shell, cast iron volute, two-vane enclosed semiopen or recessed vortex nonclog cast iron pump. Impeller shall be cast iron with a stainless steel shaft and stainless steel fasteners and have upper and lower ball bearings. Pump shall be oil-lubricated or factory-sealed grease lubricated with a ceramic mechanical seal. Pump shall be capable of passing 1 1/2-inch solids.

4. Motors: The motor shall be submersible-type, ball-bearing design, and oil-filled with built-in thermal overload protection sized for nonoverloading over the entire pump curve. Motor housing shall be filled with dielectric pure, clean insulating oil. Motor shall have precision mechanical seal to prevent leakage into the housing. Seal faces shall be carbon and ceramic, super lapped for long leakproof life. Power cord and float switch cords shall be provided in lengths adequate to reach the control panel as provided by pump manufacturer. Pump motor shall be nonoverloading over the entire curve.
5. Controls:
  - a. Electrical components specified within this section shall be provided in accordance with Division 26–Electrical Specifications and Section 40 70 00. All electrical equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 26.
  - b. Auxiliary Contact(s): There shall be an auxiliary contact from the HWL alarm signal for remote indication at the SCADA.
  - c. Provide a single ON/OFF UL listed float switch or piggyback pressure switch for pump operation. Coordinate location of receptacle with electrical contractor.
6. Accessories: Piping: Provide dual check valves, full port ball valves, union or flange for each pump discharge, and flexible connectors.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Unless otherwise specified, installation of piping shall be in accordance with Section 40 05 02–Piping and Appurtenances.
- B. Plumbing system shall be installed with hangers and supports in accordance with the Plumbing Code. Insulation shields shall be used at supports of insulated piping.
- C. Plumbing system shall be installed in accordance with local plumbing requirements and applicable portions of the Wisconsin Commercial Plumbing Code. Where requirements conflict, the stricter standard shall apply.
- D. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the general contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster walls or ceilings, furnish the access doors to the general contractor.
- E. CONTRACTOR shall identify piping, valves, and outlets in accordance with Division 09 and Section 23 05 53 –Equipment Identification.
- F. Install plumbing equipment where indicated in accordance with manufacturer’s recommendations. Coordinate equipment location with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- G. Startup and test equipment adjusting operating and safety controls for proper operation.
- H. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.

- I. Provide isolation valves at plumbing equipment.

### 3.02 TESTING AND CLEANING

#### A. General:

1. All new piping shall be tested. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
2. All piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests, flushing, sterilization. CONTRACTOR shall also provide all temporary sectionalizing devices and vents as required.
3. All new and parts of existing altered, extended, or repaired plumbing system piping shall be tested for leaks and defects. Piping being tested shall not leak nor show any loss in test pressure for duration specified.
4. In cases of minor installation and repairs where specified water and/or air test procedures are deemed impractical, CONTRACTOR shall perform alternate testing procedures if acceptable to ENGINEER. Alternate testing procedures for minor installation and repairs may include visual evaluation of installed components by ENGINEER during a simulation of use.
5. The water used for tests shall be obtained from a potable source of supply.
6. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After testing has been accepted for portions thereof, certify in writing the time, date, name, and title of the persons reviewing the test. This shall also include the description of what portion of the system has been accepted. A complete record shall be maintained of all testing that has been accepted and shall be made available at the jobsite. Upon completion of the work, all records and certifications regarding testing shall be submitted to ENGINEER before final payment is made.
7. Verify systems are complete, flushed, and clean prior to testing. Isolate or remove components subject to damage or not rated for test pressure. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. Leave piping uninsulated, uncovered, and unconcealed until it has been tested. Where any portion of piping system must be concealed before completion of entire system, the portion shall be tested separately as specified for the entire system prior to concealment. CONTRACTOR shall expose all untested covered or concealed piping.
8. Gauges used for testing shall have increments as follows:
  - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
  - b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
  - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.
9. Separately test above- and belowground piping.
10. Do not introduce test water into piping systems when exposure to freezing temperatures is possible.
11. Do not introduce test water into sections of piping located above existing sensitive areas and/or equipment that may be damaged or contaminated by water leakage. Coordinate with OWNER to determine areas and/or equipment considered as being sensitive.

12. Defective work or material shall be reworked and replaced and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.
13. CONTRACTOR shall be responsible for cleaning up any leakage during flushing, testing, repairing, and disinfecting to the original condition any building parts subjected to spills or leakage.
14. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground pressure mains prior to testing with the exception of thrust restrained valves that may be exposed to isolate potential leaks.
15. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
16. For air or nitrogen tests, gradually increase the pressure to not more than one-half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be accepted until it can be demonstrated that there is no measurable loss of test pressure during the test period.

B. Drainage and Vent System:

1. Subject gravity drainage and vent piping and joints to a vertical water column pressure of at least 10 feet. If after 2 hours, the level of the water has been lowered by leakage, the leaks must be found and stopped and the water level shall again be raised to the level described and the test repeated until, after a 2-hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
2. Piping located above sensitive areas and/or equipment that may be damaged or become contaminated because of test water leakage shall be tested with air. Air test may also be performed when allowed by ENGINEER. Isolate the test section from all other sections and slowly fill pipe with oil-free air until there is a uniform gauge pressure of 5 pounds per square inch. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.
3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to ENGINEER.
4. Test plugs must extend outside the end of pipe to provide a visible indication for removal after the test has been completed.
5. Each floor drain P-trap that has successfully passed pressure testing shall be proven clean and free of debris as follows:
  - a. A request shall be submitted to OWNER, identifying the quantity and location of drain(s) to be observed.
  - b. Vacuum out each floor drain P-trap. An observation of the trap shall be performed to verify that the trap is debris free.
  - c. Perform a free-flowing test by pouring two 5-gallon buckets of water down the floor drain.
  - d. After confirming that the floor drain trap is clean and free of debris, the trap shall be filled with water.
  - e. At the discretion of ENGINEER, an observation of the trap using a sewer scope may be required in addition to, or in lieu of, a vacuum procedure.



6. OWNER may require that any portion of the drainage, waste, and vent systems installed be proven undamaged, clean and free of debris. Verification of the interior condition of piping shall be accomplished using a sewer scope or other method as acceptable to ENGINEER.

System	Test Medium	Initial Test Pressure	Duration	Pressure	Final Test Duration
Sanitary Waste and Vent	Water	N/A		10 feet water	2 hours

- \* Leakage on exterior mains 3 inch and larger may not exceed leakage calculated as follows:

$$\text{GPH Allowable Leakage} = \frac{(\text{Feet of Pipe}) (\text{Inches Diameter of Pipe}) (\text{Test Pressure})^5}{133,200}$$

END OF SECTION

## SECTION 23 05 53

### PIPING AND EQUIPMENT IDENTIFICATION

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: Perform all work required to furnish and install equipment, valve, pipe, and wire identification with supplementary items necessary for proper installation as specified herein, or shown on the drawings. CONTRACTOR shall identify including, but not limited to, all equipment, valves, piping, ductwork, dampers, pumps, and wires.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00-Submittals.

##### 1.03 REFERENCES

- A. All material, installation, and workmanship shall comply with the applicable requirement and standards addressed within the following references:
  - 1. ASME A13.1-Scheme for the Identification of Piping Systems.
  - 2. NFPA 13-Installation of Sprinkler Systems.
  - 3. NFPA 14-Installation of Standpipe and Hose Systems.

#### PART 2-PRODUCTS

##### 2.01 NAMEPLATES

- A. Type "A" Nameplates:

Use: Fans.

Unit heaters, etc.

Size: 4-inch by 4-inch.

Material: 3-layer laminated Micarta.

Background Color: Black.

Character Color: White.

Character Size: 1 1/4 inches.

Engraving: Equipment label.

Mounting Location: Equipment-Top wireway.

- B. Type "B" Nameplates:

Use: Identify control stations, thermostats, etc.

Size: 3/8-inch by 2-inch.

Material: 3-layer laminated Micarta.

Background Color: Black.

Character Color: White.

Character Size: 1/8 inch.  
Engraving: Control station number or equipment controlled.  
Mounting Location: Device front at top.

C. Type "C" Nameplates:

Use: All equipment not specifically mentioned above.  
Size: As necessary.  
Material: 3-layer laminated Micarta.  
Background Color: Black.  
Character Color: White.  
Character Size: 3/16 inch.  
Engraving and Mounting Location: As requested by ENGINEER.

2.02 LABELING TAGS

- A. Valve Tags: All new valves shall be tagged. CONTRACTOR shall provide on valves, engraved 2 1/2-inch by 2 1/2-inch plastic laminated tags, Seton "Setonply Series M4550-H," or equal. Nomenclature for tagging (letters and numbers) will be provided by ENGINEER. Colors will be selected by OWNER. CONTRACTOR shall affix tags to valves with Brady 38091, or equal, stainless steel wire and Brady 38090, or equal, zinc wire clamps.

2.03 WIRE MARKERS

- A. Wire markers shall be permanently attached wraparound adhesive, sleeve- or heat-shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable.
- B. Wire markers shall be specifically printed for this project using a wire marker printer. Handwritten markers are not acceptable.

2.04 PIPE MARKERS

- A. Manufacturers: Marking Systems, Inc., Seton Name Plate Company, W.H. Brady Company, or equal.
- B. Pipe markers shall conform to ANSI A13.1. Arrow markers must have same ANSI background colors as their companion pipe markers or be incorporated into the pipe identification marker.
- C. Plastic Pipe Markers: Factory-fabricated, flexible, semirigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Pipe markers and arrow markers also shall be provided for all piping systems.
- E. Use Seton Setmark type SNA or Brady Snap-on type identification for all piping systems, up through 6 inches. For piping systems larger than 6 inches, use Seton or Brady strap-on markers, or similar, by Marking Services, Inc. Self-adhesive labels are not acceptable. Provide lettering in accordance with table below.

## PIPE MARK SIZE CHART

Outside Pipe Diameter (Including Covering)	Minimum Length of Label Field Color (Inch)	Minimum Height of Letters (Inch)
3/4 inch to 1 1/4 inch	8	1/2
1 1/2 inch to 2 inch	8	3/4
2 1/2 inch to 6 inch	12	1 1/4
8 inch to 10 inch	24	2 1/2
Over 10 inch	32	3 1/2

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements and referenced standards and conform to code and ordinances of authorities having jurisdiction.
- B. Degrease and clean surfaces to receive nameplates.
- C. Install nameplates parallel to equipment lines.
- D. Affix nameplates with stainless steel screws or sticky-back adhesive.
- E. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8-inch hole to accommodate wire tie.
- F. Prepare and install neatly typed directions in all panels, including existing panels, where work is done under this Contract.
- G. Four-inch-round, 4-inch-square, and 4 11/16-inch junction boxes concealed above ceilings may be identified with neat lettering on the cover with a permanent-type black marking pen.
- H. Fans serving hoods shall be labeled with direction of fan rotation, and name and location of hood served.

#### 3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, control panels, thermostats, junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Wire markers shall be permanently attached wraparound adhesive or heat-shrink-type markers. Wire numbering preprinted on the conductor, individual wraparound numbers, and flag-type labels are not acceptable.
- B. Conductors in pull boxes, motor control centers, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

#### 3.03 PIPE MARKERS

- A. Install pipe markers in accordance with manufacturer's instructions.

- B. Install in clear view and align with axis of piping.
- C. All pipes shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Locate identification at maximum 20-foot centers on straight runs, including risers and drops adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Labels shall be abbreviated as noted under fluid abbreviations on drawings.
- D. All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10 feet and with at least two labels in each room, closet, or pipe chase.
- E. Labels shall identify fluid being conveyed and include flow direction arrow. Provide a double-ended arrow marker when flow can be in either or both directions.
- F. Indicate delivered water temperature on domestic hot water supply and return lines.
- G. CONTRACTOR shall include a schedule in its submittal identifying the various pipe designations, abbreviations, and labeling scheme. Colors, text, and piping abbreviations are to be selected by OWNER, with the following piping marker scheme used where applicable.

Pipe Contents	Label Colors (Background/Text)
Other Lines	
Exhaust	Blue/White
Plumbing drains and vents	Green/White
Natural Gas	Brown/White

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Balancing air systems.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASHRAE 11—Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.
  - 2. SMACNA—HVAC Systems Testing, Adjusting, and Balancing.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Prior to final balancing, submit a preliminary report that includes the following design information for all control modes. Design information shall be from approved shop drawings. Report shall compare design and field tested data.
  - 1. For each supply, return and exhaust register, and ceiling outlet:
    - a. Room number.
    - b. Type of register and outlet and catalog size.
    - c. Air flow factor.
    - d. Design CFM and velocity.
    - e. Actual CFM and velocity.
    - f. Percent of design CFM.
    - g. Room pressure relationship.
  - 2. For each fan:
    - a. Unit number.
    - b. Fan size and wheel type.
    - c. Motor horsepower.
    - d. Motor nameplate voltage and amps.
    - e. Design CFM and static pressure (total pressure).
    - f. Actual CFM and static pressure (total pressure).
    - g. Actual fan RPM.
    - h. Actual motor voltage and amps (each phase).

- C. Provide summary sheet describing mechanical system deficiencies. Where not physically observable, provide pressure and/or flow readings to demonstrate suspected deficiencies. Describe objectionable noise or drafts found during testing, adjusting, and balancing. All deficiencies shall be corrected prior to final balancing.
- D. Upon completion of final balancing, provide updated report indicating changes to system during final balancing for all control modes including updated airflows, pressures, velocities, etc. Final report shall be submitted prior to substantial completion.

#### 1.04 QUALITY ASSURANCE

- A. Obtain services of an independent testing organization to perform testing and balancing work. The organization shall have a certified membership in the Associated Air Balance Council (AABC) or certification by the National Environmental Balancing Bureau (NEBB).
- B. Division 23 shall provide a technician and/or controls contractor to observe and assist in balancing the system. Balancing report must include verification of participation, including name and contact information of assisting party.

### PART 2--PRODUCTS

#### 2.01 BALANCING EQUIPMENT

- A. CONTRACTOR shall have the following minimum equipment for balancing systems:
  - 1. Duct air velocities below 1,000 fpm: Pitot tube and Micro-Manometer or Alnor velometer and duct-jet using zero to 1,000 fpm range.
  - 2. Water Flows: Ultrasonic Dopler Flow Meter for water systems.
  - 3. Supply Register Velocities: Alnor velometer and applicable jet or Anemotherm.
  - 4. Fan Rotative Speed: Timec tachometer or RPM counter and stop watch (1-minute reading, minimum).
  - 5. Contact pyrometer 0 to 300°F range.
  - 6. Amprobe model RS-3, or equal.
  - 7. Calibrated pressure gauge (0 to 100 feet water head).
  - 8. Inclined manometer 0 to 30 inches of water.
  - 9. Instruments used for measurements shall be accurate, and calibration shall be calibrated by the manufacturer or an AABC-approved method.
  - 10. Instruments shall be applied in accordance with manufacturer's instructions.
- B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards.

### PART 3--EXECUTION

#### 3.01 PRELIMINARY BALANCING

- A. Division 23 shall provide an experienced installer to review the air distribution system with the testing and balancing agency for completion to confirm the test openings and volume dampers indicated on the drawings or called for in the specifications are installed, that dampers are in the open position, that the fans operate properly during all control modes,

air filters are clean, and that the system is ready for balancing. Add test openings, volume dampers, air scoops, deflectrols, turning vanes, etc., as required. Adjust and change fan drives and belts, remove and reinstall ceilings, air terminals, access doors, and air devices as required to balance the system. Maintain the air handling equipment in good operating condition during the testing and balancing procedures.

- B. Coordinate with Division 23 and equipment manufacturer to obtain readings where access is difficult or limited. Lack of readings due to inaccessibility will not be accepted.

### 3.02 SCHEDULE OF TOLERANCES

- A. Final air system measurements shall be within the following range of specified cfm:
  1. Fans: 0% to +10%.
  2. Supply grilles, registers, diffusers: 0% to +10%.
  3. Return/exhaust grilles, registers: 0% to -10%.
  4. Room pressurization air: -5% to +5%.

### 3.03 GENERAL REQUIREMENTS

- A. Perform testing, balancing, and adjusting procedures in accordance with AABC or NEBB, unless specified below.
- B. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation for all control modes and any deficiencies found.
- C. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- D. Division 23 shall correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work, including sheave and pulley replacement or corrections to the controls system. Test and balance agency shall notify CONTRACTOR of these items and instructions will be issued to Division 23 for correction of the deficient work. Testing and balancing reports shall be submitted only after all deficiencies have been corrected and balancing completed upon the corrected system.
- E. In areas with suspended ceilings, remove ceiling tiles to accomplish balancing work. Replace tiles when work is complete. If ceiling tile is damaged during balancing, it shall be balancing contractor's responsibility to replace at no additional cost to OWNER.

END OF SECTION



## SECTION 23 07 00

### HEATING, AIR CONDITIONING, AND VENTILATION INSULATION

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes:
  - 1. Rigid board fiberglass insulation.
  - 2. Adhesives, mastic, sealants, and reinforcing materials.
  - 3. Jacketing.
  - 4. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:
  - 1. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 2. ASTM C168—Standard Terminology Relating to Thermal Insulation.
  - 3. ASTM C272—Water Absorption of Core Materials for Sandwich Constructions.
  - 4. ASTM C533—Calcium Silicate Block and Pipe Thermal Insulation.
  - 5. ASTM C547—Standard Specification for Mineral Fiber Pipe Insulation.
  - 6. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 7. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - 8. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - 9. ASTM C916—Standard Specification for Adhesives for Duct Thermal Insulation.
  - 10. ASTM C1071—Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - 11. ASTM C1290—Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
  - 12. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
  - 13. ASTM D1000—Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
  - 14. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 15. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
  - 16. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
  - 17. EPA Method 8260B—Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry (Gc/Ms).
  - 18. NFPA 262—Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

### 1.03 SUBMITTALS

- A. Submit a schedule of all insulating materials shall be used on the project, including adhesives, fastening methods, and fitting materials, along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

### 1.04 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all pipe and duct covering, jackets, insulation, vapor barriers, adhesive, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 150 or less when tested in accordance with ASTM E84.
- B. All pipe and duct covering, jackets, insulation, vapor barriers, adhesive, and mastics within active return or supply air plenums shall have flame spread rating of 25 or less and smoke-developed rating of 50 or less when tested in accordance with ASTM E84.
- C. Exposed ductwork shall be painted in accordance with Section 09 91 00-Painting. CONTRACTOR shall coordinate colors with OWNER.

## PART 2-PRODUCTS

### 2.01 RIGID BOARD FIBERGLASS INSULATION

- A. Acceptable manufacturer is Manville Spin-Glas Series 814, Owens Corning Type 703, or Knauf Insulation Board.
- B. Insulation shall be mineral fiber type conforming to ASTM C612.
- C. Minimum nominal density shall be 3 lbs/ft<sup>3</sup>.
- D. K-factor shall not exceed 0.23 (btu-in)/(hr-ft<sup>2</sup>-°F) at 75°F mean.
- E. Insulation shall be rated for service to 450°F.

### 2.02 JACKETING

- A. Self-Adhering Jackets (SAJ):
  - 1. Acceptable manufacturers are 3M VentureClad 1577CW, or equal.
  - 2. Jackets shall be 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) moisture permeance.
  - 3. Minimum material thickness shall be 6 mils.
  - 4. Minimum puncture resistance shall be 25 lbs conforming to ASTM D1000.

### 2.03 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

### PART 3-EXECUTION

#### 3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D. All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required.

#### 3.02 RIGID BOARD FIBERGLASS INSULATION INSTALLATION

- A. Provide finished edges at all access doors and ends of insulation.
- B. Provide additional insulation trim pieces over flanged ductwork joints to completely insulate and seal to the thickness specified.
- C. For exterior ductwork, insulate duct such that minimum thickness is maintained and is sloped/peaked to shed water.
- D. Flexible connections from ducts to HVAC equipment shall not be insulated.

#### 3.03 PROTECTIVE JACKET INSTALLATION

- A. Self-Adhering Jackets (SAJ):
  - 1. Install according to manufacturer's recommendations. Cut allowing minimum 4-inch overlap on ends and 6 inches on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.
  - 2. Wrap elbows, fittings, valves and butt joints with two layers of vapor retarding tape. Vapor retarding tape shall be compatible with the jacket material used.

### 3.04 DUCTWORK INSULATION

- A. Provide insulation on new and existing remodeled ductwork as indicated in the following schedule:

Service	Insulation	Jacket	Thickness
Exhaust/Relief Ducts from Exterior to 12 Inches Beyond Damper	Rigid Board Fiberglass	SAJ	2.0"
Intake and Exhaust Damper Frames	Rigid Board Fiberglass	SAJ	2.0"

END OF SECTION

## SECTION 23 11 23

### FACILITY FUEL GAS PIPING

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: All facility fuel gas pipe and fittings unless otherwise noted.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. Wisconsin Administrative Code SPS 365–Fuel Gas Appliances and applicable standard(s).
  - 2. NFPA 54–National Fuel Gas Code (Current Edition).
  - 3. ANSI B16.3–Malleable Iron Threaded Fittings.
  - 4. ASTM A53–Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - 5. ASTM A234–Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

##### 1.03 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

##### 1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept piping on-site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.

- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by installing temporary covers, completing sections of the work and isolating parts of completed system.
- D. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.

#### 1.06 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.
- D. Use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

### PART 2-PRODUCTS

#### 2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Natural gas pressures shall not exceed 5 psig on customer side of the meter.
- C. Buried natural gas shall be in accordance with Section 33 52 16-Fuel Gas Distribution Utilities.

#### 2.02 NATURAL GAS

- A. 2-Inch and Smaller: ASTM A53, type E or S, standard weight (schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- B. Exposed piping shall be painted in accordance with Section 09 91 00-Painting. All aboveground piping shall be labeled in accordance with Section 20 05 53-Identification for Fire Suppression, Plumbing, and HVAC Piping and Equipment.

## 2.03 VENTS AND RELIEF VALVE DISCHARGE PIPING

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

## 2.04 UNIONS AND FLANGES

- A. 2-Inch and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.
- B. Provide ASTM A 193 B7 grade bolts and A 194 2H grade nuts and hardened washers for connections (star washers for grounding).

## 2.05 GASKETS

- A. Fuel Oil and Natural Gas Systems: Branded, compressed, non-asbestos sheet gaskets. Klingsil C4401, Garlock 3000, or JM Clipper 978-C.

## PART 3-EXECUTION

### 3.01 PREPARATION

- A. Remove all foreign material from interior and exterior of pipe and fittings.

### 3.02 INSTALLATION

- A. Support:
  1. All interior or exposed pipelines shall be securely supported by adjustable metal saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile.
  2. Strap hangers, tin clips, or U-hooks will not be acceptable.
  3. In general, the maximum spacing of supports shall not exceed 10 feet on centers.
  4. Insulation saddles shall be used. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the drawings.
  5. The weight of the piping shall be supported independently of connected equipment.
  6. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so that stress will not be transferred to them.
  7. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
  8. The following maximum spacings shall be provided for supports:

**MAXIMUM HORIZONTAL PIPE  
HANGER AND SUPPORT SPACING**

Nominal Pipe or Tube Size	Black Steel (See Note 1) ft
3/4	8
1	8
1 1/4	8
1 1/2	8
2	10
2 1/2	10
3	10
4	10
5	10
6	10
8	10
10	10
12	10

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

9. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
10. Provide saddles or shields under piping hanger and supports for all insulated piping to prevent crushing of insulation. Provide stainless steel pipe shields under stainless steel piping to prevent indentation of piping from the support or clamp.
11. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping.

**B. Penetrations:**

1. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping.
2. The sleeve diameter shall not exceed the pipe O.D. (or flange O.D. where applicable) plus 2 inches, unless otherwise shown on drawings.
3. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with an approved mechanical seal.
4. Where pipes pass through a roof, they shall be run through an approved roof penetration with flashing and counter-flashing.
5. Where pipes pass through nonwatertight walls, the annular space shall be grouted full.
6. Where pipes pass through nonwatertight floors, the sleeve shall extend 1-inch above the finished floor elevation, and the annular space shall remain open.
7. Space between wall sleeve or wall pipe and concrete shall be filled with nonshrinking mortar.
8. The annular space between the wall sleeve and pipe shall be sealed with an approved mechanical seal.



9. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and grouted full (walls), remain open (floors).
10. Plug abandoned pipes and wall pipes, after pipe and fitting removal, flush to the concrete surface with nonshrinking mortar, or as otherwise acceptable, to achieve a watertight seal.
11. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the drawings or specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case, where such cutting or core drilling is necessary, shall reinforcing rods be cut or disturbed without prior consultation with ENGINEER.
12. All openings for pipe work shall be neatly patched in a workmanlike manner.

C. Layout:

1. Install all piping parallel to building walls and ceilings and at heights that do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
2. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings and floors, to permit access for covering of pipe and painting work.
3. Care shall be taken in laying out piping that there is no interference with the proper location of piping for other purposes or other equipment, and shall be run with regard to the requirements of each service.
4. Piping shall not interfere with headroom or clear floor space.
5. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings, constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
6. An ample number of unions shall be provided in all threaded, soldered, and glued pipelines and at all equipment to facilitate removal and replacement. Install a shutoff valve at each appliance.
7. In joining two dissimilar types of pipe, standard fittings shall be used when available. The proposed joint shall be submitted by CONTRACTOR to ENGINEER for review prior to installation.

### 3.03 ERECTION

- A. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- B. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.
- C. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

### 3.04 THREADED PIPE JOINTS

- A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### 3.05 NATURAL GAS

- A. Pitch horizontal piping down 1-inch in 60 feet in the direction of flow. Install a 4-inch minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- B. Do not install gas pipe in a ventilation air plenum.
- C. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.
- D. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.
- E. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- F. Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.

### 3.06 VENTS AND RELIEF VALVE DISCHARGE PIPING

- A. Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than 6 feet above a roof line. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- B. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminate with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least 7 feet abovegrade or pedestrian traffic and a minimum of 3 feet above or 10 feet horizontally from all air intakes or building openings. Provide stainless steel insect screens on vent outlets.

### 3.07 UNIONS AND FLANGES

- A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.
- B. Provide dielectric isolation device where nonferrous lines connect to ferrous lines or equipment, such as dielectric union, coupling, or dielectric flange fitting.

3.08 PIPING SYSTEM LEAK TESTS

- A. Piping system shall be tested as a complete unit or in sections. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section and test medium in an adjacent section, unless two valves in series are installed with a valved "telltale" located between these valves.
- B. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- C. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required by local code. Tester shall submit pneumatic tests to ENGINEER.
- D. Conduct pressure test with air. Test time and pressure shall be as indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by ENGINEER. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

System	Pressure	Medium	Duration
Natural Gas	Test pressure shall be no less than 15 times the proposed maximum working pressure, but not less than 3 psi. Where the test pressure exceeds 125 psi, test pressure shall not exceed 50% minimum yield strength of pipe.	Air, carbon dioxide, nitrogen, or inert gas.	1/2 hour per 500 cubic feet pipe volume not to exceed 24 hours. Test duration shall be not less than 1/2 hour for each 500 cubic feet of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet the test duration shall be a minimum of 60 minutes. The duration of the test shall not be required to exceed 24 hours.

- E. Gradually increase the pressure to not more than one half of the test pressure; then increase pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. After testing is complete, slowly release the pressure in a safe manner.
- F. All necessary piping, fittings, blind flanges, and apparatus for conducting tests shall be furnished by CONTRACTOR and shall comply with the requirements of NFPA 54 and as required by local codes.
- G. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed in table above. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.

- H. Test pressure shall be measured with a manometer or with a pressure-measuring device designed and calibrated to read, record or indicate a pressure loss caused by leakage during the pressure test period.
- I. Piping system shall withstand test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate a leak unless can be attributed to some other cause.
- J. Leakage shall then be located by means of a gas detector, a noncorrosive leak detection fluid, or other leak detection method. Matches, candles, open flames or other methods that provide a source of ignition shall not be used.
- K. When placing system into operation, appliances and equipment shall not be placed into operation until piping system has been checked for leakage with above requirements.

END OF SECTION

## SECTION 23 31 00

### DUCTWORK

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Duct Pressure/System Class.
  - 2. Duct Materials.
  - 3. Insulated Flexible Ductwork.
  - 4. Fasteners, Hangers and Supports.
  - 5. Duct Sealants and Gaskets.
  - 6. Ductwork Fabrication.
  
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A36-Standard Specification for Carbon Structural Steel.
- B. ASTM A90-Standard Test Method for Weight (Mass) of Coating on Iron or Steel Articles with Zinc or Zinc Alloy Coatings.
- C. ASTM A167-Standard Specification for Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A480-Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- E. ASTM A653-Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- F. ASTM B209-Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- G. AWS D9.1-Sheet Metal Welding Code.
- H. NBS PS 15-Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.
- I. NFPA 90A-Installation of Air Conditioning and Ventilating Systems.
- J. NFPA 90B-Installation of Warm Air Heating and Air Conditioning Systems.
- K. SMACNA-HVAC Air Duct Leakage Test Manual.
- L. SMACNA-HVAC Duct Construction Standards-Metal and Flexible.
- M. UL 181-Factory-Made Air Ducts and Connectors.

N. SMACNA–Thermoplastic Duct (PVC) Construction Manual.

### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Provide layout drawing for review prior to ductwork fabrication. Layout drawings shall be coordinated between all other trades prior to review.

### 1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 00–Contract Closeout.
- B. Record actual locations and sizes of ducts and duct fittings. Record changes in fitting location sizes and types. Show additional fittings used.

### 1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

### 1.06 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A standards.

### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain recommended minimum temperatures during and after installation of duct sealants.
- C. Ductwork shall be stored indoors or in durable, waterproof, abovegrade packing.

### 1.08 DUCTWORK DESIGN

- A. Duct layout and design shown on the drawings are based on design of supply, return and exhaust system components. Any changes to the design for installation shall be submitted to and approved by OWNER and ENGINEER. Proposed changes shall be submitted with layout and pressure drop calculations. CONTRACTOR shall be responsible for the cost of any changes to the duct system or any system components.

## PART 2–PRODUCTS

### 2.01 DUCT PRESSURE/SYSTEM CLASS

- A. Ductwork shall be constructed to the static pressure class as shown below, unless otherwise noted. Exhaust air ductwork: 2-inch negative pressure class.

## 2.02 DUCT MATERIALS

- A. All sheet metal used for construction of duct shall be 24 gauge, or heavier, except for round ductwork 12 inches and smaller shall be 26 gauge where allowed by SMACNA.
- B. Galvanized steel ducts shall be ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating in conformance with ASTM A90, A653. Sheet metal for ductwork noted or specified to be painted shall include "Paint Grip" finish.
- C. Hanger rod shall be ASTM A36 galvanized steel for galvanized ducts, or 316 stainless steel for ducts other than galvanized; threaded both ends, threaded one end, or continuously threaded.

## 2.03 FASTENERS, HANGERS, AND SUPPORTS

- A. Ductwork shall be supported in accordance with SMACNA–HVAC Duct Construction Standards–Metal and Flexible. Secure wire method of support is not acceptable.
- B. Inserts and Fasteners: Fasteners to ductwork shall be 316 stainless steel unless otherwise indicated.
- C. Hangers:
  - 1. Strip hangers shall be galvanized steel.
  - 2. Hanger rod shall be ASTM A36 galvanized steel for galvanized ducts or 316 stainless steel for ducts other than galvanized. Rods shall be continuously threaded. Rod in corrosive areas shall be electro-galvanized, all threaded rod or hot-dipped galvanized rod painted after installation.
- D. Supports:
  - 1. Duct support material shall be galvanized steel for galvanized duct. Material for supports in corrosive spaces shall be electro-galvanized.
  - 2. Acceptable supports for trapeze hangers are steel angles or uni-strut. Exposed ductwork shall be supported by steel angle supports painted to match duct.
  - 3. Riser supports shall be angles or channels secured to the sides of the duct with welds or fasteners.

## 2.04 DUCT SEALANTS AND GASKETS

- A. Duct sealant shall be United McGill–United Duct Sealer, or equal for indoor applications and United McGill–Uni-Weather Duct Sealer, or equal for outdoor applications. Sealant shall be UL classified for flame and smoke development and shall be suitable for mating materials.
- B. Gaskets at flanged joints shall be butyl rubber or EPDM.

## 2.05 DUCTWORK FABRICATION

- A. Rectangular Field and Shop Fabricated Ductwork:
  - 1. Fabricate and support in accordance with SMACNA–Duct Construction Standards–Metal and Flexible. Duct material, gauges, reinforcing, joint types and sealing shall be in accordance with required pressure class in the standard.

2. Construct tees, bends, and elbows with radius of not less than 1 1/2 times width of duct on centerline. Where not possible, rectangular elbows may be used with turning vanes in accordance with Section 23 33 00–Ductwork Accessories.
3. Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible; maximum 30 degree divergence upstream of equipment and 45 degree convergence downstream.
4. Provide 45 degree expanded entry takeoffs unless otherwise indicated. Flange ductwork for attachment to grille registers and outlets, unless otherwise noted.
5. Provide reinforcement and rigidity required for pressure class.
6. Provide cross breaking or cross beading on duct sides larger than 18 inches.
7. Seal all joints airtight with gaskets and sealants.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible.
- C. Duct sizes are inside clear dimensions. For lined or double-wall ducts, maintain sizes inside lining.
- D. Provide openings in ductwork to accommodate testing equipment and controllers. Where openings are provided in insulated ductwork, install a metal insulation sleeve of same material as ductwork.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. Make all necessary incidental changes in cross-section, offsets, etc., to avoid interference with other equipment and supports.
- F. Use double nuts and lock washers on threaded rod supports.
- G. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- H. Provide an experienced installer to go through the air distribution system with the balancer.
- I. The weight of the ductwork shall be supported independently of connected equipment.
- J. Inserts shall be coordinated with general contractor for installation concrete.
- K. Strip hangers are acceptable in concealed spaces only.
- L. Where ducts pass through non-fire rated partitions in interior or exterior walls, provide flange on four sides on both sides of partition concealing opening. Flange shall overlap opening all around by 2 inches. Fill space with insulation if duct is insulated on either side of partition.



- M. Where ducts pass through fire rated partitions in interior or exterior walls, install fire damper sleeve in accordance with manufacturer's recommendations.

END OF SECTION

## SECTION 23 33 00

### DUCTWORK ACCESSORIES

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Duct access doors.
  - 2. Duct test holes.
  - 3. Flexible duct connections.
  - 4. Duct screens.
  - 5. Balancing dampers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NFPA 90A-Installation of Air Conditioning and Ventilating Systems.
- B. SMACNA-HVAC Duct Construction Standards-Metal and Flexible.
- C. UL 33-Heat Responsive Links for Fire-Protection Service.
- D. UL 555-Fire Dampers and Ceiling Dampers.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00-Submittals.
- B. Damper submittals shall include actual pressure drop, free area, and torque requirements for each type of damper provided.

##### 1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 00-Contract Closeout.
- B. Record actual locations of access doors, fire dampers, flexible duct connections, dampers, and screens.

#### PART 2-PRODUCTS

##### 2.01 DUCT ACCESS DOORS

- A. Provide Ductmate Model FD&H, or equal, access doors for ductwork. Access door hinge and cover shall be constructed of material similar to that specified for ductwork. Provide insulated access doors where ductwork is insulated. All access doors shall be gasketed.

## 2.02 DUCT TEST HOLES

- A. Provide Ventfabrics, Inc. No. 699 Instrument Test Holes, or equal, complete with gaskets and screw caps. Coordinate test hole height with insulation thickness.
- B. On uninsulated ductwork only, plastic pull-tab centered tapered plugs may be used. Plugs shall be Caplugs CPT-3, or equal, with minimum diameter of 0.36-inch.

## 2.03 FLEXIBLE DUCT CONNECTIONS

- A. Flexible duct connections in unrated spaces shall be Ventfabrics, Inc. "Ventglas®", or equal, neoprene-coated glass fabric. Fabric shall be suitable for continuous operation up to 200°F. Fabric shall have zero leakage at ±10 inches water column.

## 2.04 DUCT SCREENS

- A. Provide screens equal to Ryerson Ryex Standard, 3/4 inches, 12-gauge sheet metal with border frame for protection on open duct inlets and outlets, and as indicated on the drawings. Frame and screen shall be of similar material to ductwork.

## 2.05 BALANCING DAMPERS

- A. All balancing dampers shall be provided with locking devices to hold the dampers in a fixed position without vibration. Single blade dampers shall be stiffened to operate in a stable manner.
  - 1. Balancing dampers for rectangular metal ductwork 12 inches high or less and for round metal ductwork shall be single blade manual balancing dampers of same material as specified for the ductwork. Dampers shall conform to SMACNA standards for single blade-type volume dampers.
  - 2. Balancing dampers for rectangular ductwork over 12 inches high shall be Greenheck VCD-20, or equal, multi-blade volume dampers of same material as specified for the ductwork. Damper blades shall be 3V type of 16-gauge construction. Bushings shall be nylon. Axles shall be 1/2-inch diameter. Blade operation shall be opposed. Damper shall include an indicator to show position of the blades. Where dampers are installed in vertical ductwork, provide dampers with jamb seals designed for vertical duct installation.

## 2.06 DAMPERS AND ACTUATORS

- A. Outside Air Intake and Exhaust Outlet:
  - 1. Dampers shall be TAMCO Series 9000 BF, Alumavent Series 3900SS, or Arrow AFDTI-25LT, thermally insulated control damper with aluminum construction.
  - 2. Dampers shall be parallel blade.
  - 3. Extruded aluminum (6063T5) damper frame shall be thermally broken, minimum 0.080 inch thickness. Damper frame to be 4 inches deep and shall be insulated with polystyrene on four sides. Damper shall be rated at a leakage of less than 8.0 cfm per square foot at 4.0 inches of water column pressure differential at 20°F.
  - 4. Blades to be extruded aluminum (6063T5), 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.
  - 5. Blade gaskets shall be extruded EPDM; blade seals shall be silicone.
  - 6. Shaft to actuator shall be hex type, material to match damper construction.

7. Side seals shall be silicone.
  8. Dampers shall be flanged to duct type. Clear opening in damper shall be same size as ductwork.
- B. Actuators:
1. Actuators shall be Belimo NFBUP, Honeywell MS4110, or Siemens GCA, maintenance-free actuator rated at minimum 88 in-lb. of torque. Dampers shall be power-to-open, spring-closed unless otherwise specified. Actuator shall be capable of accepting 120-volt power for operation and control.
  2. Actuators shall include electronic overload protection and visual position indication throughout range of motion.
  3. Actuators shall include a manual override via a manufacturer-supplied hex crank.
  4. All actuators shall be direct-coupled to damper and mounted outside the air stream utilizing TAMCO motor mounting bracket model AL-0001, or equal unless otherwise noted. CONTRACTOR shall verify suitability of mounting bracket prior to ordering.
  5. If auxiliary switch is not used, terminate cord in nearest junction box.
  6. All actuators shall be of the same manufacturer. Manufacturer shall be responsible for furnishing quantity of actuators required to meet minimum damper torque rating, plus an additional 10% torque.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards-Metal and Flexible. Refer to Section 23 31 00-Ductwork for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts where indicated.
- C. Provide duct access doors for inspection and cleaning before and after intake louver screens, filters, coils, fans, automatic dampers, at fire dampers, underneath duct smoke detectors, and elsewhere as indicated. Provide minimum 8-inch by 8-inch size for hand access, 18-inch by 18-inch size for shoulder access, and as indicated.
- D. Division 23 shall be responsible for coordinating with testing and balancing agency and providing test holes in all locations required for testing and balancing agency to complete their scope of work.
- E. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Metal-to-metal gap shall be approximately 4 inches.
- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts for air balancing and where indicated on the drawings. Install minimum two duct widths from duct takeoff.
- G. Provide balancing dampers on duct takeoff to diffusers, grilles, and registers regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

## SECTION 23 34 00

### HVAC FANS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Centrifugal inline fans.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. AMCA 99–Standards Handbook.
- B. AMCA 210–Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- C. AMCA 300–Reverberant Room Method for Sound Testing of Fans.
- D. AMCA 301–Method for Calculating Fan Sound Ratings from Laboratory Test Data.
- E. ASTM B117–Standard Practice for Operating Salt Spray (Fog) Apparatus.
- F. NFPA 70–National Electrical Code.
- G. NEMA MG 1–Motors and Generators.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submittal shall include fan-specific performance curves showing airflow, head, and motor horsepower.

##### 1.04 QUALITY ASSURANCE

- A. Fans shall bear AMCA-certified rating seals.

##### 1.05 DELIVERY, STORAGE AND HANDLING

- A. All fans shall be stored and handled in accordance with manufacturer's instructions.
- B. Motors, shafts, and bearings shall be protected from weather and dust.

##### 1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the date established for Substantial Completion of the project.

## PART 2-PRODUCTS

### 2.01 CENTRIFUGAL INLINE FANS

- A. Acceptable manufacturers are Greenheck, Cook, or Twin City Fans.
- B. Centrifugal inline fans shall be of drive type indicated on drawing schedules. Fan performance shall be as indicated on equipment schedules. Fans shall be UL listed.
- C. The fan wheel shall be centrifugal with backward-inclined blades. The fan wheel shall be statically and dynamically balanced.
- D. The fan shall be quiet-operating and vibration-free. Fan performance shall include AMCA-certified air and sound ratings and AMCA seal. Furnish and install spring-type vibration isolators provided by fan manufacturer.
- E. The fan shaft shall be mounted in prelubricated ball bearing pillow blocks. Bearings shall be sealed and have a minimum L<sub>10</sub> life of 100,000 hours.
- F. The fan housing shall be all aluminum construction with square inlet and discharge collars. Provide access panels for servicing drives and motors. All fasteners shall be either stainless steel or aluminum.
- G. Fans shall be mounted on vibration isolators furnished by fan manufacturer.
- H. Belt drives shall have a sliding or pivoting motor plate for belt tensioning. The belt and motor shall be totally enclosed by a guard with tachometer holes. The motor shall be mounted out of the airstream. The fan motor shall be totally enclosed, fan-cooled, and NEMA-approved ball-bearing type. Starters and disconnects shall be provided as a part of Division 26. Motors shall be provided with a 1.15 service factor. Motors 1 hp and higher shall have a NEMA premium efficiency rating.
- I. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
- J. Where drawings indicate fan to be suitable for corrosive environments, all surfaces of fans and motor/belt guards shall be coated with 2 to 3 mils of Hi-Pro Polyester powder coating. Wheel shall be rebalanced statically and dynamically by the fan manufacturer after application of the coatings.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and drawings.
- B. CONTRACTOR shall provide all mounting hardware and accessories necessary to complete installation.
- C. Provide flexible duct connections on inlet and outlet of all fans.

- D. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.
  
- E. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

END OF SECTION

## SECTION 23 37 00

### AIR OUTLETS AND INLETS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Diffusers and grilles.
  - 2. Louvers.
  - 3. Gravity roof ventilators.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ADC 1062–Certification Rating and Test Manual.
- B. AMCA 500–Test Method for Louvers, Dampers, and Shutters.
- C. ARI 650–Air Outlets and Inlets.
- D. ASHRAE 70–Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- E. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submittal shall include a louver schedule that includes louver model, screen type, louver size, finish type, free area, face velocity, and pressure drop for each louver.
- C. For product requiring color selection, provide a hard copy color chart to OWNER for color selection.

##### 1.04 QUALITY ASSURANCE

- A. Performance of air terminals shall be in accordance with ADC 1062.
- B. Louvers shall be tested and certified in accordance with AMCA 500 and shall bear the AMCA seal.

#### PART 2–PRODUCTS

##### 2.01 DIFFUSERS AND GRILLES

- A. Acceptable manufacturers are Carnes, Price, or Metalaire. Submit standard color chart with shop drawings for selection by OWNER.



- B. EG-1: Supply grilles for sidewall and surface mounting shall be Carnes model RSDB, or equal. Grilles shall be steel construction with double deflection blades.

## 2.02 LOUVERS (EXTRUDED ALUMINUM)

- A. Acceptable louvers are Greenheck ESD 435, or equal. See drawings for sizes and locations.
- B. Blades and frame shall be extruded aluminum 6063-T5 alloy and 0.08 inch thickness.
- C. Blades shall be 35 degree drainable type spaced at 4 inches on center. Louver shall be capable of a velocity of 1,077 fpm with no water penetration. Performance shall include AMCA-certified air and moisture penetration data and louver shall bear the AMCA seal. Vertical and horizontal mullions and connections between panels shall not be exposed.
- D. Provide channel frame unless noted otherwise on the drawings.
- E. Provide aluminum screen on louver in accordance with louver schedule on drawings. All fastenings shall be stainless steel or aluminum in accordance with louver schedule on drawings.
- F. Louver free area shall be equal to or greater than attached ductwork and damper free area.
- G. Louvers shall be furnished with 3 coats of 70% Kynar 500 finish with custom color selected by OWNER. Submit manufacturer's standard color chart with shop drawings.

## 2.03 GRAVITY ROOF VENTILATORS

- A. Acceptable manufacturers are Greenheck, Carnes, or equal.
- B. Gravity roof ventilator shall be heavy gauge aluminum construction and provided with roof curb and bird screen.
- C. Manufacturer shall furnish, and CONTRACTOR shall install, a prefabricated insulated aluminum roof curb with wood blocking to match roof pitch to allow for a level curb on roof. Curb shall be sized for 1/4-inch clearance on all sides between curb and ventilator mounting flange. Curb insulation shall be 1-inch thick, 3 pounds per cubic foot rigid fiberglass board. Curb height for low side of curb shall be 12 inches unless otherwise indicated. For roof ventilators on pitched roof, manufacturer shall furnish a pitched cricketed roof curb. Roof curb shall be provided with a foam seal and an aluminum liner.
- D. Provide baked-enamel finish. Color to be selected by OWNER. Submit manufacturer's standard color chart with shop drawings. Roof curb shall be coated to match ventilator.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install diffusers, grilles, and registers in locations shown on the drawings and in accordance with manufacturer's recommendations.

- B. Clean surface of diffusers, grilles, and registers after installation.
- C. Install louvers in accordance with manufacturer's recommendations and drawing details.

END OF SECTION

## SECTION 23 82 00

### TERMINAL HEAT TRANSFER UNITS

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: Electric heaters.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NFPA 70-National Electric Code.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00-Submittals.
- B. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

##### 1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the date established for Substantial Completion of the project.

#### PART 2-PRODUCTS

##### 2.01 ELECTRIC HEATERS

- A. CONTRACTOR shall provide electric heaters of the type, size, capacity, and accessories as listed on the equipment schedule. All units shall be UL listed.
- B. All electric unit heaters shall be factory-assembled and tested.
- C. Electric Wall Heaters (EWH):
  1. Acceptable manufacturer is QMark, or equal.
  2. Furnish and install a steel cabinet for surface mounting on a standard block wall as shown on drawings. Provide a cabinet with 16 gauge steel grille bars and finished in baked enamel.
  3. Provide a direct-drive propeller fan and permanently lubricated totally enclosed motor.
  4. Provide steel-finned metal sheath electric heating elements.

5. Provide manual reset thermal overheat protection to disconnect power in the event of overheating. Provide an integral, tamper-resistant thermostat. Provide integral contactors and disconnects.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations and local codes, including minimum mounting heights above floor.
- B. CONTRACTOR shall provide all mounting hardware and accessories necessary to complete installation.
- C. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

END OF SECTION

## SECTION 23 82 16

### TEMPERATURE CONTROLS AND INSTRUMENTATION

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Electrical components.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit under provision of Section 01 33 00–Submittals.
- B. Submittal shall include control schematics with wiring and logic diagrams in addition to equipment information. All wiring shall be color coded and labeled at each end with corresponding numbers in accordance with Section 23 05 53–Equipment Identification. This numbering shall be shown on the shop and record drawings. Wiring diagrams shall be job-specific and indicate all point-to-point wiring connections. Manufacturer’s standard wiring diagrams are not acceptable.

##### 1.03 QUALITY ASSURANCE

- A. Temperature control equipment including panels and other standard marketed apparatus shall bear the nameplate of the manufacturer. The entire system including temperature control wiring shall be installed by mechanics employed by or under contract to the temperature control provider, a factory-licensed distributor, or factory-licensed dealer. The provider shall be responsible for the quality and satisfactory operation of all materials.
- B. All control panels shall bear a serialized UL label.
- C. Comply with the National Electric Code (NFPA 70) and all local codes as applicable to construction of electrical wiring devices, material, and equipment herein specified.

#### PART 2–PRODUCTS

NOT APPLICABLE

#### PART 3–EXECUTION

##### 3.01 INSTALLATION

- A. Install all equipment in accordance with manufacturer’s recommendations and Division 26.
- B. Coordinate location of exposed devices prior to rough-in. Thermostats shall be mounted where shown on the drawings. Thermostats on exterior walls shall have insulated bases.

- C. Temperature controls to be installed in or on insulated ductwork shall be installed after the insulation has been applied.
- D. Thermostats, humidistats, etc. shall be installed 48 inches above floor (top of box), unless otherwise noted. Notify ENGINEER of conflicts.
- E. Install all dampers in accessible locations with ample space to install direct-coupled actuator, housing and accessories.

### 3.02 SEQUENCE OF OPERATION

- A. Electric wall heaters (EWH) shall be controlled by an integral thermostat.
- B. Exhaust Fan (EF-01): Shall be controlled based on occupancy as determined by the light switch such that when the light switch is on, the fan shall be on. The fan shall also be controlled by a thermostat such that when the space temperature is above setpoint, the fan is on.

END OF SECTION

SECTION 23 84 16

DEHUMIDIFICATION EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Portable dehumidifier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the date established for Substantial Completion of the project.

PART 2–PRODUCTS

2.01 PORTABLE DEHUMIDIFIER

- A. Provide a packaged dehumidifier with a sealed refrigeration-type compressor. Expansion coil, fan, and condenser coil shall be furnished to maintain the relative humidity.
- B. The humidifier shall be controlled automatically by an adjustable humidistat located on the dehumidifier.
- C. A low-temperature thermostat shall be provided to prevent coil icing.
- D. Dehumidifier shall be housed in a rust-resistant steel enclosure.
- E. Dehumidifier shall operate on 115-volt, single-phase power.
- F. The dehumidifier performance shall be certified by the Association of Home Alliance Manufacturers.

PART 3–EXECUTION

3.01 INSTALLATION

- A. All dehumidification units shall be factory assembled and tested.
- B. Install unit with vibration isolators as recommended or supplied by the manufacturer.

END OF SECTION

## SECTION 26 05 00

### GENERAL ELECTRICAL REQUIREMENTS

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work includes general requirements for all electrical work.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

##### 1.02 REFERENCES

- A. ANSI/NFPA 70-National Electrical Code (NEC).
- B. ANSI/IEEE C2-National Electrical Safety Code.

##### 1.03 CONTRACT DOCUMENTS

- A. Any equipment roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.
- B. The drawings are generally diagrammatic, and CONTRACTOR shall coordinate the Work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.
- C. Hazardous or classified locations, where referenced in the Specifications or on the Drawings, shall be as defined in the NEC.

##### 1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to ANSI/IEEE C2.
- C. The rules and regulations of the federal, state, local, and civil authorities and utility companies in force at the time of execution of the Contract shall become a part of this specification.
- D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be by CONTRACTOR.

##### 1.05 CODES AND ORDINANCES

- A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and



interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

- B. In preparing a Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the drawings and specifications. All cases of serious conflict or omission between the drawings, specifications, and codes shall be brought to ENGINEER's attention, as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.
- C. When requested by ENGINEER, CONTRACTOR shall provide written calculations to show compliance with applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, conductor derating, and voltage drop. CONTRACTOR shall indicate calculation method used as well as compliance with applicable code, drawing, or specification.

#### 1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

- A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

#### 1.07 ELECTRICAL DISTRIBUTION SYSTEM

- A. Provide a complete electrical distribution system consisting of components indicated on the drawings or specified herein including, but not limited to:
  - 1. All miscellaneous equipment coordination and related appurtenances required by power company.
  - 2. 208-volt, three-phase, 4-wire service entrance conductors.
  - 3. Feeders, branch wiring, and electrical distribution equipment.
  - 4. All control wiring.
  - 5. Access panels and access doors for access to equipment installed by Division 26.
  - 6. Wiring between system components if equipment is not prewired.
  - 7. Lighting fixtures, lighting controls, and associated wiring.
  - 8. Support system design and supports for electrical raceways.
  - 9. Code-required disconnects.
- B. Provide a standby power system consisting of components indicated on the drawings (see Section 26 32 13–Standby Power System and Section 26 36 23–Automatic Transfer Switches).
- C. CONTRACTOR shall connect the following equipment furnished by other Divisions consisting of components indicated on the drawings or specified herein.
- D. Provide balancing and adjusting of electrical loads.
- E. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.

- F. Provide miscellaneous items for a complete and functioning system as indicated on the drawings and specified herein.
- G. A partial list of work not included in Division 26 is as follows: Painting (except as otherwise specified herein).

#### 1.08 NOISE

- A. Eliminate any abnormal noises that are not considered by ENGINEER to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

#### 1.09 DRAWINGS

- A. The drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.
- B. Prior to locating equipment, confer with ENGINEER as to desired location in the various areas. In no case should equipment locations be determined by scaling drawings. Relocate equipment and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.
- C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on the drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.
- D. The drawings are schematic in nature and are not intended to show exact locations of conduit, but rather to indicate distribution, circuitry, and control.

#### 1.10 EXISTING UNDERGROUND UTILITIES

- A. Record drawings of existing privately-owned underground electrical utilities are not available for this facility. CONTRACTOR shall excavate and verify the location of all underground electrical prior to installing new electrical equipment. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground electrical to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

#### 1.11 SUBMITTALS

- A. CONTRACTOR shall submit to ENGINEER for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01 33 00-Submittals for requirements.
- B. CONTRACTOR shall, in addition, submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by ENGINEER for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall

also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project: Electrical interconnection wiring diagrams; see Section 26 24 19–Motor Control and Section 26 09 00–Controls and Instrumentation.

- C. These drawings and diagrams shall show applicable electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.
- D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:
  - 1. Proper sizes and capacities.
  - 2. That the item will fit in the available space in the manner that will allow proper service.
  - 3. Construction materials and finishes.
- E. When the manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. The shop drawings shall be clearly marked and noted accordingly.
- F. When equipment and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.
- G. See additional requirements of shop drawings under Division 01–General Requirements.

## PART 2–PRODUCTS

### 2.01 STANDARD PRODUCTS

- A. All equipment and products shall be of new manufacture per applicable specifications.
- B. All equipment shall be UL and NEMA approved.
- C. Unless specified otherwise, major distribution equipment such as panelboards, motor starters, SPD, transformers, etc., shall each be by the same manufacturer.
- D. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, raintight, explosionproof, dustproof, or any other special type).

### 2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of substitute material or equipment sufficient data to show conclusively that it is equivalent to that specified in the following respects:
  - 1. Performance:
    - a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
    - b. Energy consumption at the point of rating shall not exceed that of the specified equipment.

- c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
  2. Materials of construction.
  3. Gauges, weights, and sizes of all portions and component parts.
  4. Design arrangements, methods of construction, and workmanship.
  5. Coatings, finishes, and durability of wearing parts.
  6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
  7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.
- B. Requests for substitution shall include CONTRACTOR's reason for the request.
- C. If ENGINEER does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.
- D. See General Conditions for additional requirements.

### PART 3-EXECUTION

#### 3.01 UTILITY SERVICES

- A. Utility connection requirements shall be determined. All costs for coordinating utility service shall be included in the price bid as described in Section 26 21 00-Electrical Service System of these specifications.
- B. All costs for temporary service, temporary routing of piping, or any other requirements of a temporary nature associated with the utility service shall be included in the Base Bid.
- C. It is the intent that in the latter stages of construction, the permanent electrical service will be used and the temporary construction service discontinued. The following requirements shall govern the use of the permanent services:
1. No permanent service shall be available until structure is enclosed, watertight, and heated.
  2. Only permanently connected and protected circuits and outlets shall be available.
  3. Temporary wiring shall not be connected to permanent distribution equipment.
  4. Under the above conditions, the use of permanent service equipment shall in no way affect the Contract conditions of the guarantee.
- D. It shall be CONTRACTOR's responsibility to police this situation and protect its equipment.

#### 3.02 CONTINUITY OF SERVICE

- A. CONTRACTOR shall provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.
- B. No service shall be interrupted or changed without permission from OWNER. Written permission shall be obtained before any work is started.

- C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

### 3.03 CLEANUP AND REMOVAL OF RUBBISH

- A. All lighting and appliance panelboards, motor starter and disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cut off before installation of covers.
- B. All lighting fixture lenses (interior and exterior fixtures) shall be cleaned at the time of installation, and all lens exteriors shall be cleaned just prior to final inspection.
- C. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

### 3.04 CONCRETE WORK

- A. All cast-in-place concrete for new electrical equipment bases shown on the drawings shall be provided by CONTRACTOR, except where specifically noted to be provided by others. All new equipment shall be set on 3 1/2-inch minimum leveling slabs including free-standing enclosures. Pads shall be 3 inches larger than equipment being supported.
- B. Concrete shall comply with Section 03 30 00–Cast-In-Place Concrete.
- C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

### 3.05 PAINTING

- A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.
- B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.
- C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR.
- D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

### 3.06 CAULKING

- A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.
- B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.

- C. Caulking sealant shall contain no acid or ingredients that will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

### 3.07 BUILDING ACCESS

- A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.
- B. When the installation requires openings and access through existing construction and the openings are not provided, CONTRACTOR shall provide the necessary openings.

### 3.08 COORDINATION

- A. Provide wiring for all motors and all electrically powered or electrically controlled equipment.
- B. All starters, disconnects, relays, wire, conduit, push buttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the drawings.
- C. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size, horsepower rating, or means of control be made to any motor or other electrical equipment after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.
- D. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters as specified herein.
- E. CONTRACTOR shall provide all line voltage power and control wiring (100 volts and above), including temperature control wiring for operation, control, and supervision of all motorized equipment, including wiring between motor starters, and control devices as specified herein and as shown on the drawings. Low-voltage control wiring (below 100 volts) shall be provided by CONTRACTOR supplying the equipment that has low-voltage wiring, unless otherwise noted. CONTRACTOR shall provide raceways for all low-voltage wiring.
- F. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.
- G. Motors 1/2 hp and larger shall be NEMA rated 460 volts, three-phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115 volts, single-phase, 60 Hz, unless otherwise shown.

### 3.09 EXCAVATION AND BACKFILL

- A. Backfilling of all trenches beneath concrete floor and stair slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 33 00 00–Excavation, Fill, Backfill, and Grading. Refer to Section 26 05 33–Conduit for additional requirements associated with PVC conduit installed in earth.

- B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.
- C. Care shall be taken so that there is no disturbance of bearing soil under foundations.

### 3.10 EQUIPMENT ACCESS AND LOCATION

- A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems that are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.
- B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials that will fit properly the types of finishes actually installed.
- C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.
- D. Electrical equipment, devices, instruments, hardware, etc., shall be installed with ample space allowed for removal, repair, calibration or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment that is to be installed or that is already in place.
- E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. ENGINEER shall reserve the right to make minor position changes of the outlets before the work has been installed.

### 3.11 WORKMANSHIP

- A. All work shall be performed in compliance with the NEC.
- B. Install work using procedures defined in NECA Standard of Installation.
- C. Location of process equipment as shown on the drawings is approximate.
- D. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.
- E. Locations of utilization equipment and control devices as shown on the drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance will be performed at no additional cost to OWNER.
- F. Unless otherwise noted, conduit shall be fastened to building structure or equipment framework and not placed on the floor.

- G. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the Bid.
- H. Materials and equipment of the types for which there are National Board of Fire Underwriters Laboratories (UL) listings shall be so labeled and shall be used by CONTRACTOR.

3.12 AREA CLASSIFICATION

- A. As noted on the drawings.

3.13 MODIFICATIONS TO EXISTING CONSTRUCTION

- A. CONTRACTOR shall remove all electrical equipment, conduit, and wiring associated with the structure, equipment, and control systems specified herein and/or shown on the Drawings to be removed.
- B. Include in Bid removal of existing electrical material and equipment as specified hereinafter, as noted on the drawings, or as needed by field conditions.

END OF SECTION



## SECTION 26 05 19

### WIRE

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Wire.
  - 2. Terminal blocks and accessories.
  - 3. Wiring connections and terminations.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01 33 00–Submittals.
- B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- C. Submit manufacturer's instructions.

##### 1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-wrapped, waterproof, flexible-barrier material for covering wire on wood reels, where applicable, and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

- B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

## PART 2--PRODUCTS

### 2.01 WIRE

- A. All wire for permanent installation shall be new stranded copper delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multiconductor cable is NOT ALLOWED.
- B. Motor circuit branch wiring and associated control wiring:
  - 1. Insulation type shall be as specified herein.
  - 2. Minimum size for motor control wiring associated with field devices shall be 14 AWG. Motor control wiring in starters shall be minimum 16 AWG.
  - 3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on drawings.
- C. Minimum size for field wiring associated with control panels and supervisory control stations shall be 14 AWG. Control wiring within control panels and supervisory control stations shall be minimum 18 AWG.
- D. All control wiring within starter enclosures, control panels, and supervisory control stations shall be 600-volt, insulation type THHN/THWN/TFFN or MTW. All field control wiring shall be 600-volt rated, insulation-type THHN/THWN.
- E. Wiring for feeders and branch circuits 12 AWG and larger shall be 600-volt, insulation type XHHW-2.
- F. Refer to Section 26 05 53--Electrical Identification for required wire color coding and labeling. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.

### 2.02 LOW-VOLTAGE WIRING (LESS THAN 100 VOLTS)

- A. Low-voltage wiring specified in this section shall be applicable to all systems installed that utilize low-voltage wiring where such wiring is not specified in other technical sections.
- B. All wiring shall have copper conductors with 300-volt insulation rating and meet the requirements of NEC Article 725.
- C. All conductors must be suitable for the application intended. Conductors 16 AWG and larger shall be stranded. Conductors 18 AWG and smaller may be solid or stranded.
- D. Control Cable for Class 1 Remote Control and Signal Circuits: Individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the National Electrical Code.

- E. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the NEC Article 725.

## 2.03 WIRING CONNECTIONS AND TERMINATIONS

- A. Provide crimp type UL or ETL listed terminations for 6 AWG and smaller stranded conductor connections to electrical devices and equipment such as receptacles, switches, and terminal strips. Crimp devices shall be Sta-kon, or equal.
- B. Provide insulated, silicone-filled spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Dryconn Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes. Spring wire connectors are not allowed for terminating motor conductors.
- C. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of split-bolt connector and motor-lead pigtail splice kit. Individual components shall be as follows:
  - 1. Split-bolt connectors shall be for use with copper conductors only.
  - 2. Pigtail splice kit shall consist of one-hole lug cover, silicone grease, and mastic sealing strip. Pigtail splice kit shall have locking pins for conductors 2 AWG and larger. Kit shall be as manufactured by 3M, or equal, 5300 series, and be selected based on motor, feeder, and lug sizes installed.
- D. No splices will be allowed unless reviewed by ENGINEER. Where allowed, provide in-line splices for all conductor connections, 6 AWG and larger. Splice crimp component shall be Burndy UGSKIT2 or equal. Splice shall be made with crimp tool by manufacturer that allows expanded conductor ranges. Splice insulation component shall be Raychem heavy-wall, low-voltage tubing, type WCSM, or equal.

## 2.04 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: 600 volt, screw terminal type with mounting strips, solid jumpers (as required), and end caps. Terminals shall be DIN-rail mounted, Allen-Bradley Bulletin 1492-J4, no equal. DIN-rail shall be Allen-Bradley.
- B. Power Terminals: Open construction block, tubular screw without pressure plate, 600 volts, Allen-Bradley Bulletin 1492-CXX, 20-80 amps, no equal.
- C. Signal and Control Terminals: Recessed terminals for finger-safe protection, Allen-Bradley Bulletin 1492-J4, 19 amps and less, 300 volts or less, no equal. Knife-blade disconnect terminal blocks shall be Allen-Bradley Bulletin 1492-JKD volts or less, no equal.
- D. Terminal Blocks for Power Meters and Current Transformers: Provide test-disconnect terminal blocks for disconnecting, shorting, and testing current transformers and for disconnecting and testing voltage sensing inputs. Provide test-disconnect terminals for individual current transformer and voltage sensing inputs for each power meter installation.
  - 1. Provide a pair of terminal blocks for each current transformer including one feed-through terminal block, one sliding disconnect terminal block with a cross-connection short-circuit slider. The pair of terminal blocks shall include the following:
    - a. Feed-through terminal block shall be Weidmüller Model WTD 6/1 EN, or equal.

- b. Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
  - c. Short-circuit slider shall be Weidmüller Model WKS 2/2, or equal. The short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shorting position, and expose the terminal block conductor screws when slid into the shorting position.
  - d. Provide two cross-connection sliders Weidmüller Model STB, or equal, with connecting sleeves Weidmüller Model VH, or equal. Provide one slider fixing screw Weidmüller Model BS, or equal. Connecting sleeves and fixing screws shall be color coded for each current transformer.
2. Provide disconnecting terminal blocks for each voltage sensing and neutral connection. The terminal blocks shall include the following:
    - a. Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
    - b. Provide one cross-connection slider Weidmüller Model STB, or equal, with connecting sleeve Weidmüller Model VH, or equal, for each voltage sensing and neutral connection terminal block. Provide one slider fixing screw Weidmüller Model BS, or equal. The neutral connecting sleeve shall be a different color than the voltage sensing connecting sleeves.
  3. Terminal block colors shall be gray. Provide end plates and end brackets as required to complete the test-disconnect terminal block assembly.
- E. Terminal blocks shall have self-locking screw compression clamps rated for the size of conductors being terminated and upstream overcurrent protection for each application.
  - F. The same manufacturer and style of terminal block shall be used throughout the entire project for all applications.
  - G. Terminal blocks shall have tin-plated copper current bars and tin-plated steel screws. Terminal housings shall be completely finger safe from all live circuits and be constructed of self-extinguishing material with minimum UL 94-V0 flammability rating.
  - H. Terminal blocks shall accept pre-printed, snap-in labeling cards on both sides without increasing the installed space. Provide terminal block manufacturer's end barriers and screw-type retainers for all terminal block groupings.
  - I. Terminal blocks shall mount on standard DIN rail and shall be able to be removed without removing adjacent terminal blocks.
  - J. Multi-level terminal blocks and stacked, single-level terminal block installations are not acceptable.
  - K. Refer to Section 26 05 53—Electrical Identification for terminal block labeling requirements.

## PART 3—EXECUTION

### 3.01 GENERAL WIRING METHODS

- A. Install electrical wire and connectors in accordance with the manufacturer's written instructions, applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices so that products serve the intended functions. Use appropriate wiring methods and materials for the equipment or environment.

- B. Stranded conductors shall be terminated using crimp-type devices specified herein. Conductors may not be wrapped around a terminal screw.
- C. Place an equal number of conductors for each phase of a circuit in same raceway.
- D. Torque conductor connections and terminations with calibrated torque wrench to manufacturer's recommended values. Provide permanent marking on lug, bolt, nut, or connection for conductors larger than 4 AWG.
- E. Splice only in junction or outlet boxes. Splicing is not allowed in disconnects, panelboards, control panels, control devices, equipment, etc. Avoid splices between terminals of interconnecting power and control wiring.
- F. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways (e.g., motor control centers, panelboards, disconnects, switchgear, etc.), and control panels shall not have any spring-wire connectors installed; all terminations shall be on terminal strips.
- G. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, starters, and panelboard. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system. Wiring in starters shall be protected by spiral wrapping wires in groups from the conduit system to plastic wireways or the final terminations inside the starter or panel.
- H. Make conductor lengths for parallel circuits equal.
- I. The same color shall be used for each numbered wire throughout its entire length.
- J. Terminate all wiring on terminal blocks in control panels, starter enclosures, and similar equipment. This shall include all spare or unused wires. Do not install wiring over or under terminal blocks. All terminal blocks shall be installed on stand-offs 3/4 inches off of the enclosure back panel.
- K. Provide a dedicated neutral for each branch circuit or feeder requiring a neutral. Ampacity of neutral conductor shall match that of the branch circuit or feeder.
- L. Do not use a pulling means that can damage the raceway.
- M. Signal wiring (below 100 volts) and intrinsically safe wiring must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop-powered devices, voice and data communications, and communication wiring (i.e., DeviceNet, RS-232, etc.). Analog wiring shall be in a conduit separate from all other wiring. Intrinsically safe wiring shall be separated and identified in accordance with Article 504 of the NEC.
- N. Provide junction or pull boxes to facilitate the "pulling in" of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.
- O. Thoroughly clean wires before installing lugs and connectors.

- P. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.
- Q. Terminate spare conductors within equipment, starter enclosures, control panels, etc., on terminal strips and label as "SPARE." Spare wiring in pull or junction boxes may be terminated with electrical tape and labeled as "SPARE." All spare conductor labels shall indicate where the conductors terminate. Refer to Section 26 05 53—Electrical Identification, for additional requirements.
- R. Feeder connections to motors shall be installed within the motor junction box utilizing factory engineered kits as specified herein. Spring wire connectors are not allowed for connections to motors.
- S. A maximum of nine current carrying conductors shall be installed in any one conduit.
- T. Provide separate conduits for the following types of cables and conductors:
  - 1. Power.
  - 2. AC Control.
  - 3. DC Control.
  - 4. Communications.
  - 5. Shielded Instrumentation.

### 3.02 GENERAL LOW-VOLTAGE WIRING METHODS (LESS THAN 100 VOLTS)

- A. Low-voltage wiring installation requirements specified herein shall be applicable to all systems installed that utilize low-voltage wiring where such wiring installation is not specified in other technical sections.
- B. Low-voltage wiring shall be installed in conduit. Unless noted in other specification sections, low-voltage wiring located in office buildings above suspended ceilings shall be allowed to be installed free air, as specified herein if the cable meets NEC requirements for the application.
- C. Control wiring for HVAC and lighting equipment connected to emergency power shall be installed in conduit.
- D. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts. All sizes subject to NEC 725 requirements.
- E. Low-voltage cable splices are not allowed.

### 3.03 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Wax-based pulling lubricant is not allowed unless it includes a Teflon additive.
- B. Install wire in raceway after interior of building is enclosed, watertight, and dry, and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.

- D. Conductors No. 6 AWG and larger shall be pulled into conduits utilizing a tugger with built-in tension meter. CONTRACTOR shall provide a report to ENGINEER for each pull indicating maximum tension reached during the pull along with manufacturer's maximum pulling tension. Motorized machines of any type are NOT ALLOWED for any wire pulling.
- E. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.
- F. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation or provide larger boxes approved for additional capacity.
- G. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.
- H. Circuiting is indicated diagrammatically on the drawings.

#### 3.04 TERMINAL BLOCK INSTALLATION

- A. A maximum of one conductor shall be installed on the field-wired side of each terminal block. If rated to accept more than one conductor, a maximum of two conductors shall be installed on the enclosure-wired side of each terminal block. Provide additional terminal blocks and shorting jumpers as required.
- B. Provide a separate ground-type terminal block for each shielded-cable drain conductor.
- C. Provide ten percent spare terminal blocks for each type of connected terminal block, minimum five spare terminal blocks total. For each grouping of terminal blocks, provide 25% spare DIN rail space.
- D. Maintain a minimum of 1 1/2 inches between terminal blocks and adjacent devices and enclosure wireways.

#### 3.05 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.
- C. Subsequent to wire hookups, energize circuitry and demonstrate functionality in accordance with these specifications.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- E. Perform field inspection and testing according to provisions of this section.

### 3.06 ACCEPTANCE TESTS

- A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.
- B. CONTRACTOR shall be responsible for powered tests of each field-installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.
- C. Operation Test: By operational testing, OWNER will give final acceptance of the wiring system when all the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.
- D. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.
- E. The feeder to the lighting panel shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C as follows:
  - 1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.
  - 2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

### 3.07 WIRE INSTALLATION SCHEDULE

- A. Install all wiring in raceways except as otherwise noted. This includes all low-voltage wiring such as temperature control, instruments, antenna, etc.

END OF SECTION



## SECTION 26 05 23

### INSTRUMENT AND COMMUNICATION WIRE AND CABLE

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this section as listed in Division 01.
- B. Qualifications of Installers: Skilled workers who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

##### 1.03 PRODUCT HANDLING

- A. Instrument cable shall be furnished in lengths as necessary.
- B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00-Submittals.

##### 1.05 QUALIFICATIONS

- A. CONTRACTOR shall have at least 10 years of experience in the installation of similar systems. CONTRACTOR shall provide documentation upon request to certify that all assigned staff have attended training courses corresponding to the type of cabling and equipment specified herein.
- B. CONTRACTOR shall currently be licensed to install low voltage electronic cabling systems in the state of the project.
- C. CONTRACTOR shall currently meet all manufacturer's requirements for the provision and installation of all equipment specified herein.

## PART 2-PRODUCTS

### 2.01 SHIELDED PAIR CABLING FOR ELECTRONIC INSTRUMENTS

- A. Shielded pair (2/C) and triad (3/C) cabling shall have stranded, 18 AWG, tinned-copper conductors twisted with 4.8 twists per foot.
- B. Insulation of conductors shall be 21 mil, 90°C minimum PVC, rated for 600 volts. Materials shall equal or exceed UL TC requirements for physical properties.
- C. Color coding shall be manufacturer's standard, black.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 45 mils thick, and 90°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of the UL vertical tray flame test. Cable shall meet NEC requirements for Type UF cable.
- E. A bare, tinned-copper drain wire with an aluminum polyester shield tape shall be integral to the cable.
- F. Single-pair, shielded cables shall be Belden 8719, or equal.
- G. Triad shielded cables shall be Belden No. 8618, or equal.
- H. RTD shielded cables shall be Belden No. 83503 or 9533, or equal.

### 2.02 INDUSTRIAL ETHERNET CABLE

- A. 300-Volt Rated Unshielded Cable:
  - 1. For communication with plant SCADA Systems and motor starter overloads, supervisory control centers, and control panels without VFDs, etc., under 300 volts, and other areas or raceways with power wiring under 300 volts, provide 300-volt-rated, 4-pair, shielded (F/STP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 5e performance criteria as defined by the ANSI/TIA-568-C.2 standard. Cables installed in SCS-Thurber can be unshielded (U/UTP).
  - 2. Industrial Ethernet cable shall be minimum 24 AWG with PVC jacket. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.24 inches. Cable shall be CMR rated, UL listed, and shall be Allen-Bradley Bulletin 1585, no equal.
  - 3. Cable jacket color shall be teal.
  - 4. Provide unshielded RJ45 connectors on both ends of each cable.

## PART 3-EXECUTION

### 3.01 INSTALLATION REQUIREMENTS AND SPECIAL CONSIDERATIONS

- A. Shielded pair and industrial Ethernet cabling specified in this section shall be installed in conduit, and may not be run free-air or in nonmetallic tubing such as innerduct.

### 3.02 GROUNDING

- A. Shielded cabling shall be installed in accordance with manufacturer's instructions and to minimize electrical noise and interference to associated instruments. Refer to instrument manufacturer's instructions for additional requirements.
- B. Ends of signal wires shall be sealed to prevent the migration of moisture into the cable and to prevent unintentional grounding of the shield at the open end. Seal signal wires using a minimum 1-inch piece of heat-shrink tubing installed over PVC jacket and individual wires, and heat-shrink to a watertight fit.
- C. All shields must be grounded.
- D. Shields shall be grounded at one point only. Shielded cabling shall be isolated and left open at the instrument.
- E. Cable shield grounds shall be isolated from control system grounds, except at instrument system grounding electrodes.

END OF SECTION

## SECTION 26 05 26

### SECONDARY GROUNDING

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Power system grounding.
  - 2. Electrical equipment and raceway grounding and bonding.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00-Submittals.

#### PART 2-PRODUCTS

##### 2.01 MATERIALS

- A. Ground Rods: Copper-bonded, 5/8-inch diameter; minimum length 10 feet.
- B. Ground Connections Below Grade: Exothermic type by Cadweld, or equal.
- C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, KG, GBL, or equal.

##### 2.02 GROUND ROD INSPECTION WELL

- A. Ground rod inspection wells shall be polymer concrete with a Tier 15 Design load-rated, bolt-on, non-slip cover. Wells shall be ERICO Model T416, or equal. Length and width shall be a maximum 16-inch and depth shall be as required by CONTRACTOR

#### PART 3-EXECUTION

##### 3.01 INSTALLATION

- A. Provide a grounding conductor in all conduits. Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Provide a dedicated neutral conductor sized to match the circuit or feeder conductors for each feeder or branch circuit requiring a neutral. Terminate each end on a grounding lug, bus, or bushing. Provide an insulated ground bushing to bond the grounding conductor to the conduit system when conduits are terminated without threaded hubs.

- B. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, and receptacle ground connectors.
- C. Connect grounding electrode conductors to metal frame of building or structure and structural reinforcing bars using suitable ground clamps.
- D. Ground system and equipment as required by code and local ordinances.
- E. All feeder neutrals shall be connected to neutral at only one point in the lighting panel.
- F. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.
- G. A minimum of three ground rods at 15-foot separations near the building service entrance shall be provided. These shall be connected to the main service circuit breaker disconnect ground bus by conductors sized to code requirements. The above are minimum requirements.
- H. All grounding electrode conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90-degree bends are not allowed.
- I. Include ground for grounded receptacles, light fixtures, motors, and equipment items shown on the drawings.
- J. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, or equipment frame to conduit system.
- K. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each fixture or device.
- L. Separately derived systems as defined by the National Electrical Code shall be grounded as such. This shall include, but not be limited to, 4-wire standby generators.
- M. Refer to Section 26 05 23–Instrument and Communication Wire and Cable for additional grounding requirements.

### 3.02 TESTING

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three-point "Fall-of-Potential" test. The test results shall include a graph of the results plus a diagram of the testing layout. The remote current probe (C2) shall be placed a minimum of 100 feet from the ground system potential/current probe (P1/C1) or as required to provide sufficient spacing to demonstrate a resistance plateau on the graph. The ground resistance shall be tested with the potential probe (P2) between the P1/C1 probe and the C2 probe at 10% intervals starting at 0% and ending at 100% of the distance between P1/C1 and C2, 11 points total. A single point of

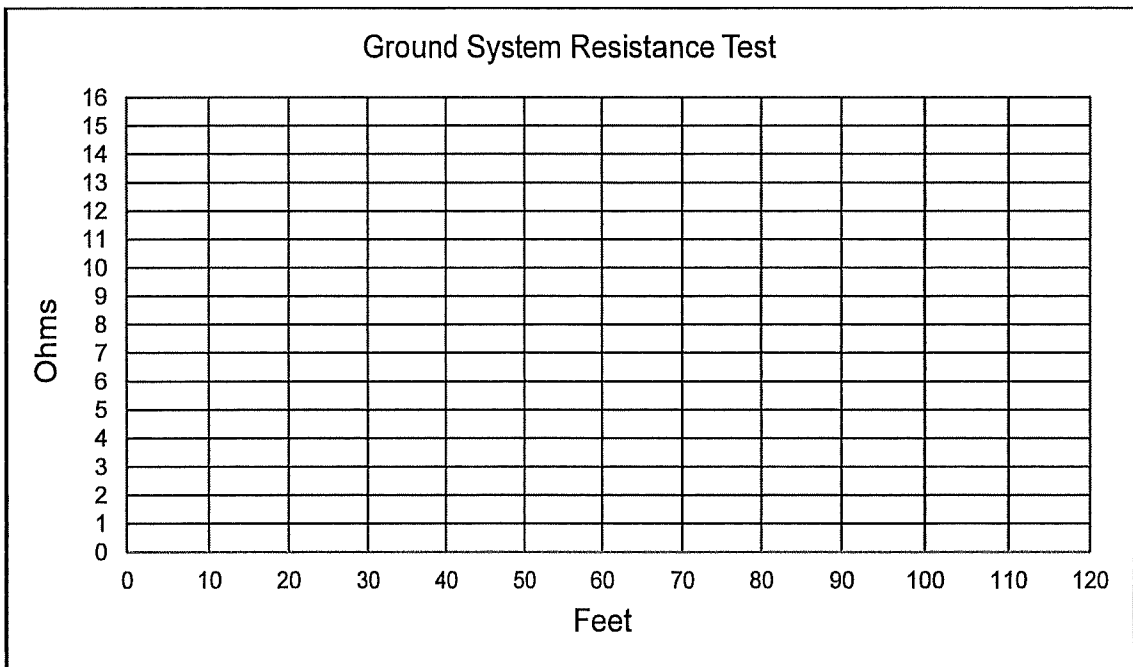
measurement is not acceptable, and the two-point method of ground system testing shall only be used where there is no or insufficient "open earth" area to use the three-point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by ENGINEER or OWNER. ENGINEER shall be notified a minimum of 72 hours in advance of all ground system testing.

- C. The test meter shall be Associated Research Vibroground test set with null balance, James A. Biddle Megger Earth-Tester-Null Balance, or equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test report.
- D. Ground resistance testing shall be performed with all rods connected and shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.
- E. Multiple ground rod grids shall be isolated from all metallic connections such as from grid under test to other grounded structures and electrical system neutrals.
- F. Provide test report using the attached Form 26 05 26. Each ground grid, including service entrance transformers, switchgear, etc., shall have a form submitted.

END OF SECTION

GROUND ROD RESISTANCE TO EARTH TEST RECORD

- 1. DATE \_\_\_\_\_
- 2. PROJECT NAME \_\_\_\_\_
- 3. LOCATION OF TEST \_\_\_\_\_
- 4. GROUND ROD TYPE \_\_\_\_\_  
DIAMETER \_\_\_\_\_ LENGTH \_\_\_\_\_
- 5. TEST METHOD \_\_\_\_\_  
INSTRUMENT TYPE \_\_\_\_\_  
SERIAL NO. \_\_\_\_\_
- 6. REQUIRED MAXIMUM RESISTANCE TO EARTH \_\_\_\_\_
- 7. MEASURED RESISTANCE TO EARTH \_\_\_\_\_  
GROUND ROD SYSTEM \_\_\_\_\_



TEST PERFORMED BY: \_\_\_\_\_  
Signature

TEST WITNESSED BY: \_\_\_\_\_  
Signature

SECTION 26 05 29  
SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Conduit and equipment support members.
  - 2. Fastening hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MATERIAL

- A. Support Members: 316 stainless steel.
- B. Hardware: Including, but not limited to, threaded rods, anchors, nuts, bolts, washers, hangers, conduit support clamps, V-bolts, and L-brackets: 316 stainless steel.
- C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. All supporting devices and support structures shall be constructed such that the structure adequately supports the load of the equipment installed on it including any wind and/or snow loads. Provide additional support members to those shown on the Drawings to adequately support load.
- B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or support members. Do not use spring steel clips and clamps. Provide standoffs or suspended ceiling grid bridge supports as specified in other technical sections.



- C. Use toggle bolts or hollow wall fasteners in hollow masonry; expansion anchors or preset inserts in solid masonry walls; expansion anchors on concrete surfaces; and sheet metal screws in sheet metal studs.
- D. Where support members are used for conduit, cutoff ends shall be ground smooth.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- F. Do not use powder-actuated anchors.
- G. Do not drill structural steel members.
- H. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring-lock washers under all nuts.
- I. Install surface-mounted cabinets and panelboards with a minimum of four anchors.
- J. Do not use chain, wire rope, or perforated strap hangers.

END OF SECTION

## SECTION 26 05 33

### CONDUIT

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Rigid metal conduit and fittings.
  - 2. PVC externally and internally coated galvanized rigid metal conduit.
  - 3. Polyvinyl chloride conduit and fittings.
  - 4. Liquidtight flexible metal conduit and fittings.
  - 5. Conduit seals and special fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI C80.1-Electrical Rigid Steel Conduit (ERSC).
- B. ANSI/NEMA FB 1-Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- C. NEMA RN 1-Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.
- E. Prior to shipment to the site, all conduit provided shall be new, unused material and may not have been stored outdoors or exposed to weather.
- F. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

## 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

## 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.
- B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.
- C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.

## PART 2–PRODUCTS

### 2.01 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: ANSI C80.1 and UL6. Heavy wall seamless tubing with hot-dipped galvanized coating.
- B. Conduit bodies for rigid steel conduit shall be as manufactured by Appleton, Form 35, no equal, and be constructed of stamped steel for sizes 2 inches and under, and cast malleable iron for sizes over 2 inches. Conduit bodies shall have built-in pulling rollers, domed gasketed covers, and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- C. PVC-coated conduit and fittings shall be internally and externally hot dipped galvanized rigid metal conduit with hot dipped galvanized threads and PVC coating. PVC coating shall be UL listed with rigid metal conduit as the primary means of corrosion protection for the conduit, and PVC coating shall have an external 40 mil thickness with an internal 2 mil urethane coating. Acceptable manufacturers shall be Plasti-bond RedH<sub>2</sub>OT by Robroy Industries, Ocal-Blue by Thomas & Betts, or equal. PVC-coated conduit and fittings shall meet the following listings and manufacturing standards, without exception. All installers shall be field-certified from the factory for installation and shall provide proof of certification:
  - 1. ANSI C80.1.
  - 2. UL6.
  - 3. NEMA RN1.
- D. Conduit bodies for PVC-coated rigid conduit shall be as manufactured by Plasti-bond RedH<sub>2</sub>OT by Robroy Industries, Ocal-Blue by Thomas & Betts, or equal, and have a 40 mil PVC exterior coating and 2 mil red urethane interior coating. Conduit bodies shall be Form 8 style or pulling elbow and include pulling rollers, domed, gasketed covers and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- E. Fittings and Conduit Bodies: ANSI/NEMA FB 1 and UL 514B; threaded-type material to match conduit. For hazardous locations, fittings and conduit bodies shall meet the requirements of UL 886. Split couplings are not allowed.

- F. Supports: One-hole malleable iron clamps with back spaces or stainless steel hangers may be used for surface-mounted conduit. Clamps and back spacers shall be PVC-coated where used with PVC-coated conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 26 05 29—Supporting Devices. Support material shall match that of the conduit type provided.

## 2.02 POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

- A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and aboveground applications. PVC conduit installed in exterior locations shall be UV resistant.
- B. Conduit bodies for PVC conduit shall be as manufactured by Carlon, or equal, and be suitable for use with Schedule 40 or Schedule 80 PVC conduit. Conduit bodies shall have smooth hubs, textured lids, and foam-in-place gaskets. CONTRACTOR shall select body style and size per application.
- C. Supports: Two-hole nonmetallic clamps or conduit support straps may be used for surface-mounted conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 26 05 29—Supporting Devices. Support material shall match that of the conduit type being provided.

## 2.03 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Liquidtight Flexible Metal Conduit:
  - 1. Conduit: Spiral-wound, hot-dipped galvanized, single-strip steel with integral grounding conductor continuously enclosed within the entire length of the convolutions. The flexible PVC jacket shall be sunlight-resistant, flame-retardant, and resistant to damage from mild acids. Conduit shall be UL Listed and be rated for installation in Class I, Division 2, Groups C and D locations. Conduit shall be Liqueflex Type LA, or equal.
  - 2. Fittings: UL listed with thermoplastic elastomer sealing gasket.
    - a. Provide stainless steel fittings outdoors and in damp/wet locations, unless noted otherwise.
    - b. Provide electro-zinc plated steel fittings in all other areas, unless noted otherwise.
  - 3. Connectors: Appleton Model STB, no equal, in interior locations, and PVC-coated by the same manufacturer as the PVC-coated conduit outdoors and wet locations.

## 2.04 FLEXIBLE CONDUIT COUPLINGS (HAZARDOUS LOCATIONS)

- A. Flexible conduit in hazardous locations shall be liquidtight, stainless steel and be rated for use in Class I locations. Outer braid and end fittings shall be stainless steel with flexible brass inner core. An insulated ground conductor shall be installed in all couplings.
- B. Couplings shall be manufactured by Appleton EX Series.

## 2.05 CONDUIT SEALS AND SPECIAL FITTINGS

- A. Conduit Unions: Where used, rigid metal conduit shall have three-piece, concrete-tight unions as manufactured by Appleton Model EC, no equal.
- B. Conduit Seals: Duct sealing compound, OZ Gedney Type DUX, no equal.

- C. Expansion Fittings: Appleton type XJ, no equal, for rigid or PVC-coated rigid conduit. Appleton, no equal for PVC conduit.
- D. Expansion Deflection Fittings: Appleton EX series, no equal.
- E. Ground Bushings: Crouse Hinds Model GIB, no equal.
- F. Mechanical Seals: 316 stainless steel, Link Seal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners.
- G. Watertight Hubs: Insulated and gasketed with bonding screw, rated for wet or dry locations indoors or outdoors. Watertight hubs shall be Appleton HUB, Type B, no equal.
- H. Conduit Plugs: Kwik N Sure pipe plug as manufactured by Cherne Industries, or equal. Plug shall include natural rubber O-ring with galvanized wing nut and hex nut.

### PART 3--EXECUTION

#### 3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4 inch minimum size. Minimum size for liquidtight flexible metal conduit is 1/2 inch.
- B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2 inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).
- C. All conduit shall be supported in accordance with the NEC and as specified herein. This shall apply to all conduit types, including flexible conduit.
- D. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.
- E. Do not conceal conduits unless indicated otherwise on the Drawings and acceptable to ENGINEER. Maintain a minimum clearance of 12 inches from all hot water pipes, flues, or any high-temperature piping or ductwork.
- F. Do not route raceways near or above high temperature equipment.
- G. Conduits shall be attached to building surfaces and not suspended unless installed in a Unistrut-type conduit rack as specified herein. Individual conduits shall not be suspended. Clevis hangers are not allowed.
- H. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice.
- I. Conduit attached to building surfaces that may be damp shall be spaced out to avoid rust and/or corrosion using fittings approved for the use. Use back straps on all conduit in damp or wet locations, or mount conduit with Unistrut straps, or equal. Watertight hubs shall be

used in all damp locations. Damp locations shall include, but not be limited to, all basement areas, all wet wells, valve vaults, all areas below grade, and exterior locations.

- J. Conduits shall be securely fastened to building structure at intervals not exceeding 8 feet or closer, if necessary. Where hangers are necessary, 3/8-inch rod/eyelets/rings/or trapeze type in Unistrut channel and pipe clamps shall be used. Wire or perforated strap iron is not acceptable. PVC conduit shall be securely fastened to building structure at intervals not exceeding 3 feet.
- K. Vertical conduit runs 1 1/4 inches and larger passing through floors shall be supported at each floor with conduit riser grips.

### 3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

- A. Interior conduit shall be run exposed on walls and ceilings. Minimize exposed conduit runs on the upper level by routing conduit below the floor slab. Exterior conduit shall be buried below grade.
- B. Run exposed conduit grouped and parallel or perpendicular to construction. Do not route exposed conduits over or in contact with high-temperature equipment.
- C. All conduit installed below grade shall be buried a minimum of 2 feet 0 inches. All conduit installed below floor slabs shall be buried a minimum of 1 foot below slab.
- D. Conduit installed in earth shall be bedded in pea gravel with a minimum of 6-inch cover on all sides. Base of trench shall be compacted prior to installing conduit. Cover pea gravel with minimum 1-foot of compacted sand fill and remainder to grade with topsoil.
- E. In all PVC conduit runs below grade 200 feet and longer, PVC coated rigid steel conduit shall be used for all 90 degree bends.
- F. Ream conduit smooth at ends, cap upon installation, rigidly attach to structural parts of the building, and securely fasten to all outlet boxes, panel cabinets, junction boxes, pull boxes, splicing chambers, safety switches, and all other components of the raceway system.
- G. Provide all empty raceways 2 1/2 inches and over with No. 10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2 inches. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty conduits shall be threaded, capped and flush with finished floor or wall. Exposed conduits shall be threaded and capped.
- H. Conduit seals shall be provided for intrinsically-safe circuits, where conduits pass from the interior to exterior of the building and any conduit entering a wet location.
- I. Liquidtight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.
- J. All runs of flexible conduit and flexible conduit couplings to equipment and devices shall be as short as practicable, of the same size as the conduit it extends, and with enough slack to reduce the effects of vibration to a minimum. A minimum of 18 inches and a maximum of 36 inches of flexible conduit shall be installed for each motor.

- K. Provide conduit expansion-deflection fittings as specified herein in all conduit runs where movement perpendicular to axis of conduit may be encountered.
- L. Conduits shall be pitched so that drainage is away from all structures.
- M. Conduit bends for PVC conduit shall be made using a hot box, heat blanket, or glycol bender. Open flame or point heat sources of any type are not allowed.
- N. The PVC-coated rigid conduit manufacturer's touch-up compound shall be used on all conduit interior and exterior bare steel exposed because of nicks, cuts, abrasions, thread cutting, and reaming; minimum six coats.
- O. Where below-grade PVC conduit is connected to rigid metal conduit, the length of PVC conduit shall be a minimum of 10 feet. For short, below-grade conduit runs where required lengths of rigid metal conduit limit the length of PVC conduit to less than 10 feet, rigid metal conduit shall be used for the entire run.
- P. Conduit bodies shall not be used for antenna cable routing. Provide pull boxes sized as required for antenna cable bending radius.

### 3.03 CONDUIT PENETRATIONS AND TERMINATIONS

- A. All conduits 2 inches or smaller shall be terminated with watertight hubs. Where watertight hubs are not used, provide double locknuts and insulated ground bushing.
- B. Conduit penetrations for control panels or enclosures containing electronic equipment shall utilize watertight hubs and enter the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.
- C. Conduit penetrations for all exterior enclosures (e.g., disconnects, junction boxes, control panels) shall utilize watertight hubs and enter the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.
- D. Provide conduit expansion fittings as specified herein in all conduit runs that cross a structural expansion joint.
- E. All conduits that protrude from poured concrete shall be PVC-coated rigid conduit. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the poured concrete on the exterior side of the structure.
- F. Conduits passing through masonry, concrete, or similar construction shall be cast in place using PVC-coated rigid conduit extending completely through the construction.
- G. Where above-grade conduits pass through cores in existing structures or through masonry walls, grout openings between conduit and walls or floors with sand cement mortar.
- H. All spare conduits that terminate in a building or structure below grade shall be plugged with conduit plugs as specified herein.
- I. Where wall penetrations through existing walls are below grade, cored openings shall be sealed with waterproof mechanical seals. Cores shall be pitched slightly such that conduit slopes away from building. Sleeve diameter shall be provided and mechanical seals installed

as recommended by the manufacturer. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the wall (exterior).

### 3.04 CONDUIT INSTALLATION IN HAZARDOUS LOCATIONS

- A. All conduits installed in or passing through "hazardous locations" as defined by the NEC, NFPA, or as noted on the drawings, shall be installed with seal-offs as specified herein.
- B. All conduits in hazardous locations shall be installed in accordance with the NEC.
- C. Conduits for intrinsically-safe circuits shall be dedicated to intrinsically-safe wiring. Conduits shall be installed and identified by cabling or color coding in accordance with Article 504 of the NEC.

### 3.05 CONDUIT INSTALLATION SCHEDULE

- A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed:
  - 1. Rigid steel:
    - a. All exposed interior dry or damp locations.
    - b. Class I, Division 2 locations.
  - 2. PVC-coated rigid steel:
    - a. Class I, Division 1 locations.
    - b. Conduits protruding from concrete.
    - c. Damp or corrosive locations.
    - d. Earth.
    - e. Exterior locations and locations exposed to weather.
    - f. Within 6 feet of building or structure footing or wall.
  - 3. PVC:
    - a. Earth, except within 4 feet of a building, structure footing or wall. PVC conduit under pavement or roadways shall be Schedule 80.
    - b. Service entrance ground conductors.
  - 4. Liquidtight flexible metal conduit minimum of 18 inches but not over 3 feet in length for final connections to:
    - a. Equipment with sliding bases or flexible positioning.
    - b. Equipment with vibration isolation mounting.
    - c. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including transformers and motors.
    - d. All pumps and associated equipment.
- B. Locations:
  - 1. Dry location: Upper level.
  - 2. Damp location: Valve vault, exterior locations, and all areas below grade.
  - 3. Corrosive location: Wet well.

END OF SECTION



## SECTION 26 05 35

### BOXES

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Switch, outlet, and small junction boxes.
  - 2. Pull and junction boxes.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

##### 1.02 REFERENCES

- A. ANSI/NEMA OS 1-Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. ANSI/NEMA OS 2-Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. NEMA 250-Enclosures for Electrical Equipment (1000 Volts Maximum).

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation Work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00-Submittals.

## PART 2--PRODUCTS

### 2.01 SWITCH, OUTLET, AND SMALL JUNCTION BOXES

- A. Cast Boxes: Cast ferrous, deep-type, gasketed cover, threaded hubs, Appleton FD Series, or equal.
- B. PVC-Coated Cast Boxes: Boxes shall be by the same manufacturer as the conduit.
- C. NEMA 4X Boxes: 316 stainless steel, Eaton FD Series, or equal, where specified herein.
- D. Covers for switch and outlet boxes used as junction boxes shall have covers that match box type.

### 2.02 PULL AND JUNCTION BOXES

- A. A NEMA 12 Boxes: Painted steel with continuously-hinged cover, recessed quarter-turn latches, and gasket. Boxes shall be Hoffman Bulletin CW1, or equal.
- B. PVC-Coated Cast Boxes: Provide PVC-coated cast boxes in areas where PVC-coated conduit is used. Boxes shall be by the same manufacturer as the conduit.
- C. NEMA 4X Boxes: 316 stainless steel, Saginaw Control and Engineering, or equal, where specified herein. Boxes shall have a continuously-hinged gasket cover with clamps.
- D. Boxes Larger Than 12 inches in Any Dimension: Hinged enclosure in accordance with Section 26 27 16--Hinged-Cover Enclosures.
- E. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

## PART 3--EXECUTION

### 3.01 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.
- B. Electrical box locations shown on the drawings are approximate. Verify location and size of floor boxes and outlet boxes in all work areas prior to rough-in.
- C. Where dedicated raceways are provided for different voltage systems or wiring, (e.g., motor power wiring and motor space heaters), separate boxes shall also be provided unless acceptable to ENGINEER. Where acceptable to ENGINEER, combined boxes shall be physically divided to separate the wiring.
- D. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.
- E. Locate and install to maintain headroom and to present a neat appearance.

- F. All boxes attached to building surfaces in damp and corrosive locations shall be spaced out to avoid rust and/or corrosion. All boxes in damp locations shall be on 1/2-inch standoffs. Damp locations shall include, but not be limited to, exterior locations, all wet wells, valve vaults, all areas below grade, and any washdown areas.

### 3.02 SWITCH, OUTLET, AND SMALL JUNCTION BOX INSTALLATION

- A. Provide knockout closures for unused openings.
- B. Support boxes independently of conduit.
- C. Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- D. Install boxes in walls without damaging wall insulation.
- E. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring shall each have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g., 24 V, 120 V, 480 V) shall have dedicated pull and junction boxes for each voltage.
- F. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- G. For weatherproof switches, devices, and exterior fixtures, and interior outlet boxes in damp and corrosive locations use PVC-coated cast boxes with proper cover and gasket.
- H. All exterior, damp and corrosive location outlet boxes shall be NEMA 4X.
- I. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.
- J. Knockout punches shall be used for holes; boxes with prepunched holes are not acceptable.
- K. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so that they will support the weight of the fixture. Conduit will not be considered as adequate supports.
- L. Cast boxes with 3/4-inch hubs may be used with all conduit types. Aluminum fittings shall not be used with boxes specified herein.
- M. Provide PVC-coated cast boxes in all areas where PVC-coated conduit is used. Boxes in hazardous locations shall be rated for Class I, Division 1, Groups C and D locations. Boxes shall be by the same manufacturer as the PVC-coated conduit.
- N. All exterior outlet boxes and interior outlet boxes in damp and corrosive locations shall be PVC-coated cast boxes with proper gasket and cover.

### 3.03 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.

- C. Knockout punches shall be used for holes; boxes with prepunched holes are not acceptable.
- D. Refer to Section 26 05 33–Electrical Identification for junction box labeling requirements.
- E. All interior exposed junction and pull boxes shall be NEMA 12, unless noted otherwise.
- F. All exterior, damp and corrosive location junction and pull boxes shall be NEMA 4X.
- G. Boxes in hazardous locations shall be rated for Class I, Division 1, Groups C and D locations. Boxes shall be by the same manufacturer as the PVC-coated conduit.

END OF SECTION

## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Nameplates.
  - 2. Labeling tags.
  - 3. Wire markers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Provide schedule for nameplates and labeling tags with shop drawings. Reference drawings for type used.

#### PART 2—PRODUCTS

##### 2.01 NAMEPLATES

- A. Type "A":
  - 1. Use:
    - a. Motor starters.
    - b. Each separately mounted circuit breaker or disconnect switch.
    - c. SPD.
    - d. Each device on control panel exteriors.
    - e. Cabinets, enclosures, pull, and junction boxes.
    - f. Field devices (flowmeter transmitters, level transmitters, chemical scales, chemical leak detectors, etc.).
    - g. Communication and Network Cable Tray.
  - 2. Size: 2-inch by 3-inch.
  - 3. Material: 3-layer laminated Micarta.
  - 4. Background Color: Black.
  - 5. Character Color: White.
  - 6. Character Size: 1/4-inch.
  - 7. Engraving: See one-line and I/O list for labels, or as requested by ENGINEER. Label shall include equipment number and description (i.e., SCAL-60-01, Fluoride Scale).
  - 8. Mounting Location: Front exterior.
- B. Type "B":
  - 1. Use: Standby power systems as in "A" above.
  - 2. Size: 2-inch by 3 5/8 inch.
  - 3. Material: 3-layer laminated Micarta.

4. Background Color: Red.
5. Character Color: White.
6. Character Size: 1/4-inch.
7. Engraving: See one-line for labels, or as requested by ENGINEER.
8. Mounting Location: As requested by ENGINEER.

C. Type "C":

1. Use: Panelboards.
2. Size: 4-inch by 4-inch.
3. Material: 3-layer laminated Micarta.
4. Background Color: Black.
5. Character Color: White.
6. Character Size: 2 1/4-inch.
7. Engraving: Equipment label. Label shall include equipment number and description (i.e., LP-10-01, First Floor Power).
8. Mounting Location: Equipment: Top wire way.

D. Type "D":

1. Use: Thermostats, etc.
2. Size: 3/8-inch by 2-inch.
3. Material: 3-layer laminated Micarta.
4. Background Color: Black.
5. Character Color: White.
6. Character Size: 1/8-inch.
7. Engraving: Control station number and equipment description (e.g., T-15-01, Chlorine Room).
8. Mounting Location: Device front at top.

## 2.02 LABELING TAGS

- A. Use: Field-Mounted Devices (Valves, Limit Switches, Level Transmitters, Flow Transmitters, etc.).
1. Size: 2-inch diameter round.
  2. Material: 2-layer laminated Micarta.
  3. Character Size: 1/8-inch.
  4. Engraving: As requested by ENGINEER.

## 2.03 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be permanently-attached, project-specific, heat-shrink type labels.
1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
  2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.
  3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.
- B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Affix nameplates with weatherproof, UV-resistant adhesive in outdoor locations and sticky back adhesive in indoor locations.
- D. Affix labeling tags with stainless steel leaders; vinyl locking wire ties are not acceptable. Provide 3/8-inch hole to accommodate wire tie.
- E. Prepare and install neatly-typed directions in all panels, including existing panels where Work is done under this Contract.

### 3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Neutral conductor labels shall include the associated branch circuit number. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.
- B. Conductors in pull boxes, starter enclosures, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.
- C. Power Conductor Insulation Color Code:
  - 1. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination and at accessible locations such as junction and pull boxes, panelboards, etc. Apply tape with at least six full, overlapping wraps; minimum 2 inches wide.
  - 2. 8 AWG and Smaller: Provide conductors with color-coded insulation.
  - 3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/208 Volts Three-Phase, Four Wire	Grounded Neutral	White*
	Phase A	Black
	Phase B	Red
	Phase C	Blue
Note: Phase A, B, C implies direction of positive phase rotation.		
* When installed as part of a 120-volt branch circuit, provide a color-coded stripe on the white neutral conductor insulation matching the branch circuit insulation.		

D. Control Panel and Field-Installed Control Conductor Insulation Color Code:

1. All conductors shall have color-coded insulation.
2. Colors:

System	Conductor	Color
Supply Voltage	Ungrounded Circuit Conductors Neutral	Black White
Discrete 120-volt AC Input/Output	Control Circuit Conductor Neutral	Red White
Discrete 12/24-volt DC Input/Output	Control Circuit Conductor Common	Dark Blue White with Dark Blue Stripe
Conductors energized when the main disconnect is in the "off" position (e.g. foreign supply voltages)	Control Circuit Conductor AC Neutral DC Common Ground	Orange White White with Blue Stripe Green

E. Circuit Identification:

1. Identify power, instrumentation, and control conductors at each termination and at accessible locations such as starter enclosures, junction and pull boxes, panelboards, etc.
2. Conductors for panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
3. Control conductor identification shall match the associated terminal block label.
4. Circuits Not Listed in Circuit Directories:
  - a. Assign circuit name based on unique device or equipment at load end of circuit.
  - b. Where unique device or equipment names are not available or apparent, add a unique number or letter modifier to each otherwise identical circuit name.

3.03 DATA AND COMMUNICATION CABLE EQUIPMENT IDENTIFICATION

- A. Individual labels shall be placed on both ends of all cables.
- B. Refer to Section 26 05 23—Instrument and Communication Wire and Cable.

3.04 JUNCTION BOX IDENTIFICATION

- A. All junction boxes shall be labeled with permanent labels. Labels shall indicate circuit or load served, as well as the power source and highest voltage present on any conductor.

3.05 TERMINAL BLOCK IDENTIFICATION

- A. Terminal blocks shall be labeled on both sides of each terminal block. Labels shall be separate from each terminal and labels shall not connect with adjacent terminal blocks. Terminal block numbering shall match the numbers shown on the project-specific wiring diagrams.
- B. Fused terminal blocks labels shall be located on top of the terminal blocks and include the fuse voltage and amperage rating.



### 3.06 COMPONENT IDENTIFICATION

- A. All components (e.g., relays, timers, power supplies, transformers, etc.) shall be labeled on the back panel adjacent to the device. Labels may not be placed on the device itself, wireway covers, or any other removable devices. Labels shall be included on the as-built drawings.

### 3.07 LABELING FONT REQUIREMENTS

- A. The font for all conductor, cable, and device labels shall be Arial with black characters on white background, and minimum font size 12.
- B. The text for all conductor, cable, and device labels shall be machine printed. Handwritten labels are not acceptable.

END OF SECTION

SECTION 26 09 00

CONTROLS AND INSTRUMENTATION

PART 1-GENERAL

1.01 SUMMARY

- A. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

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1.02 SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation the Supervisory Control and Data Acquisition (SCADA) System for the City of Madison, Wisconsin, Thurber Avenue Pumping Station.
- B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all PLC cabinets, and required interface hardware and internal wiring, hardware, system drawings,

system software, new motor starters at the pumping station. See paragraph 1.08 for other System Supplier requirements. OWNER will provide all PLC and OIP programming and the SCADA System radio in the SCS.

- C. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in, or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.
- D. CONTRACTOR shall be responsible for the placing of circuits and making of electrical and hydraulic connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to provide proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in an acceptable manner. This shall include on-site review of software/hardware controls from the central control point.
- E. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier. All switches and control and indicating lights associated with the control panels shall be new and installed in the starter panels. All new controls shall be installed in new supervisory control panels as necessary by System Supplier at locations where space allows for the new equipment in the pumping station.

### 1.03 QUALITY ASSURANCE

- A. System Suppliers: Firms regularly engaged in the design and manufacture of SCADA systems of the size and complexity specified herein, and whose systems have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: A firm with at least 10 years of successful installation experience on projects with SCADA System design and installation work similar to that required for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, and connectors that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

### 1.04 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00-Submittals.

- C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.
- D. Shop drawing submittals shall be assembled in two phases; in the first submittal, the following information shall be provided in booklet form:
  - 1. Detailed catalog information, descriptive literature, and specifications of hardware. All items being provided must be specifically noted on this literature.
  - 2. All field devices and instruments.
  - 3. Project implementation plan, including information on project organization, project management, engineering, programming, configuration, training, startup, and maintenance services. Plan shall include key personnel on project, point of contact, and communication protocol.
  - 4. Overall network schematic showing all controllers, radio, and hardware addresses applicable to the system.
  - 5. Wiring diagrams for all SCSs, control panels, and motor starters, including field termination wiring with terminal identification.
  - 6. PLC I/O Listing.

#### 1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provision of Section 01 33 00–Submittals.
- B. Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.
- C. Submit Operation and Maintenance Manuals in accordance with Division 01. The following additional information shall apply. Manuals shall contain, but not be limited to, the following:
  - 1. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
  - 2. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.
  - 3. Listing of all hardware timers installed in motor starters and SCSs, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of startup.
- D. Provide final drawings in electric AutoCAD format. Drawings shall become property of OWNER.

#### 1.06 DELIVERY, STORAGE, AND HOLDING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to SCS components, enclosure, and finish.

## 1.07 COORDINATION WITH OWNER AND OWNER-FURNISHED ITEMS

- A. The Station Control System (SCS) panel and each motor starter shall be completely assembled and tested at the System Supplier's factory as specified herein. System Supplier shall provide all items specified, and OWNER will provide the following scope of work.
  - 1. Programming of SCS PLC and the Operator Interface Panel (OIP).
  - 2. Factory testing of control algorithms associated with the PLC and OIP. ENGINEER and OWNER shall also be involved in factory testing of overall system.
  - 3. Start-up and checkout of station controls associated with the PLC and OIP. ENGINEER and OWNER shall also be involved in final checkout of overall system.
- B. During the manufacturing phase and prior to the Factory Acceptance Test for the SCS, System Supplier shall schedule with OWNER, intermediate panel inspection and programming test dates at 50% and 90% completion. Dates shall be scheduled a minimum of two weeks in advance and be used for purposes of reviewing panel construction and to allow coordination with OWNER'S programming and physical equipment to be installed in the SCS.

## 1.08 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

- A. This specification, along with the Contract drawings, defines the requirements of a PLC-based process monitoring and control system. System Supplier shall construct a process monitoring and control system specifically for the demanding requirements of a real-time municipal wastewater pumping station.
- B. It is the intent of this specification to define a fully integrated open-type process monitoring and control system, factory-tested, delivered to the site, ready to function upon connection of power source and field instrument wiring. Components, peripherals, interconnections, cabling, power supplies, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for reviewing the wiring diagrams and control sequences for equipment provided under other divisions of these specifications and coordinating all interface requirements. CONTRACTOR shall submit to ENGINEER, in writing, any deficiencies noted during this review. Any changes required by CONTRACTOR because of failure to complete this review shall be the responsibility of CONTRACTOR, at no increase in cost to OWNER.
- C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, sensors, and meters supplied with input and output signals, and contacts that are compatible with the systems as specified herein. CONTRACTOR shall also be responsible for complete coordination with manufacturers of other systems specified in other divisions of these specifications with which an interface is required. The Contract drawings and I/O Listing are symbolic representatives of the required work. It is not intended that the drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the drawings, specifications, and standard industry practices.
- D. To provide a complete and totally integrated system, a single manufacturer who has experience in furnishing similar networked PLC-based monitoring and control systems of the same complexity and size for municipal wastewater pumping facilities shall provide specified equipment and services. The system proposed to meet this specification shall be of field-proven design, incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.

- E. Design and specification of devices and completed system shall conform to applicable portions of the latest edition of the National Electrical Code (NEC).
- F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled, but do not have UL approval as an assembled unit are not acceptable.
- G. Training Program:
  - 1. Submit training plan including course syllabus, personnel who will be conducting the training, and schedule at least two weeks prior to scheduled training days.
  - 2. Provide materials, instructors, and workbooks to complete the training.
  - 3. Training courses shall include:
    - a. Operator training. Course length minimum 4 hours. Training shall utilize equipment specified herein following installation and field testing. One 4-hour session shall be provided at the pumping station.
    - b. Maintenance training. Course length minimum 4 hours. One 4-hour session shall be provided at the pumping station.
  - 4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than the process itself.
- H. System Supplier shall meet the following minimum requirements:
  - 1. System Supplier shall have a full-time staff of qualified programmers who are knowledgeable in the configuration of networked computer systems and the PLCs being provided.
  - 2. System Supplier shall have a minimum of one Microsoft-certified engineer.
  - 3. System Supplier shall have training capabilities and shall have conducted training courses in programming and maintenance.
  - 4. System Supplier shall have an adequate inventory of spare parts.
  - 5. System Supplier shall have a full-time staff of qualified service technicians.
  - 6. System Supplier shall be responsible for the programming and documentation of the system.
  - 7. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
  - 8. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.
  - 9. System Supplier shall have a UL panel shop located inside the System Supplier's own facilities.
- I. All components shall be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid System Supplier shall be EvoLogic Industrial Automation, (563) 556-2144, Wunderlich-Malec Engineering, (952) 933-3222, or Integrated Process Solutions, (608) 849-4375. See General Conditions and Supplementary Conditions regarding substitutions to the Base Bid system suppliers.

## 1.09 FACTORY ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES

- A. Permit ENGINEER and OWNER to observe vendor's staging records or other quality assurance records relating to system(s) supplied. System Supplier shall assemble the system components as a complete process monitoring and control system and demonstrate that the system (SCS and motor starters) is operational before shipment from System Supplier factory to the job site. This testing shall be as an integrated assembly by simulating each of the specified I/O points and all OWNER-programmed PLC algorithms. This test shall be witnessed by OWNER and ENGINEER (three personnel). System Supplier shall provide lodging, meals, and transportation for one day and one night as a minimum for this witness test in the Bid. All problems, errors, insufficiencies, and failures identified during testing shall be resolved before shipment. In the event the equipment does not operate in accordance with the specifications, programming of controllers/computers is incomplete, or setup of equipment is incomplete, there shall be deducted from payments due CONTRACTOR the amount of \$1,500 per day each for ENGINEER's and OWNER's time plus travel and expenses, for all additional factory acceptance testing and office time spent by ENGINEER.
- B. On-Site Functional Acceptance Testing:
1. After all equipment has been installed and is placed in full-time operation, CONTRACTOR and System Supplier shall demonstrate that all equipment and controls operate in compliance with the Contract Documents. For each piece of equipment being tested, all systems associated with the operation of the equipment (e.g., controls, supply/discharge piping, etc.) shall be installed and be in full operating condition so that all equipment functions are able to be completely tested without delay using real-time process I/O.
  2. All control wiring, hardwired interlocks, etc., shall be checked out and functionally tested by System Supplier prior to ENGINEER's on-site functional acceptance testing. All functional errors shall be corrected prior to ENGINEER's on-site functional acceptance testing.
  3. Coordination Teleconferences:
    - a. CONTRACTOR shall schedule and conduct an initial functional acceptance testing coordination teleconference at least one month prior to the anticipated functional acceptance testing. Meeting shall include CONTRACTOR, System Supplier, Division 26 contractor, OWNER, and ENGINEER, and all other parties responsible for the equipment and controls scheduled for functional acceptance testing.
    - b. CONTRACTOR shall provide the following information in written form at the teleconference.
      - (1) Equipment installation and manufacturer's startup schedule.
      - (2) Status of all power and control system wiring for the equipment scheduled for functional acceptance testing.
      - (3) Schedule and status of System Supplier's on-site checkout and functional testing.
      - (4) Anticipated delays and the cause of each delay.
      - (5) Conflicts with OWNER's operation of the facility.
      - (6) Proposed dates for acceptance testing of all equipment and controls.
  4. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for ENGINEER's functional acceptance testing, ENGINEER will make one 1-day trip to check operation. CONTRACTOR and System Supplier shall be on-site during testing to adjust equipment, correct erroneous wiring, and make modifications to control equipment, as necessary. If the equipment and controls do not operate according to the Contract Documents, or if CONTRACTOR and System Supplier are not present during the scheduled testing, there will be deducted

from payments due to CONTRACTOR the amount of \$1,500 a day for ENGINEER's time plus travel and expenses, and for all additional field and office time spent by ENGINEER checking equipment. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.

5. System Supplier shall provide functional acceptance testing support through one or more on-site field service engineers. Time for the on-site field service engineers scheduled for functional acceptance testing shall be dedicated to the functional acceptance testing process and shall not be interrupted for other construction-related activities.
- C. Final acceptance and payment will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. CONTRACTOR shall include in Bid field follow-up to provide proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
1. Satisfactory operation of peripheral equipment.
  2. Wet well level sensing is reliable.
  3. Motor controls are operational.
  4. Checking and calibrating of systems have been completed.
- D. CONTRACTOR, through System Supplier, shall provide the following support services:
1. Field Service Engineer: Field service engineer shall be present at the factory acceptance test and be present for startup of all systems and available throughout the entire construction process until final completion. Service technicians sent for system startup will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
    - a. Commissioning, installation, startup, and testing of equipment.
    - b. Revising or rewriting manuals to incorporate an installed and accepted system.
    - c. On-site training.
    - d. Assistance to OWNER for startup and checkout of OWNER-provided PLC and OIP programming.
  2. In-factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:
    - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
    - b. Revising or rewriting manuals.
  3. Post-startup support shall include follow-up services during the 1-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include 8 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. It shall be assumed that these 8 hours include one trip to the site.

## 1.10 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 12 gauge steel, and hinged doors, rotating lockable handle, 3-point latch on each supervisory equipment compartment door (not screws or bolts), with top and bottom bolts actuated by one rotating handle on large doors. Provide door stop kit for all panel doors, data pockets for wiring diagrams, and minimum 24-inch, bolt-on, LED light and door switch. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, gray interior, and OWNER-selected exterior color. All doors and panels shall be gasketed. All louvers shall be



filtered with forced-air cooling as necessary by the supplier for conditions where installed. New enclosures shall be manufactured by Hoffman or Saginaw. MCC structures are not acceptable.

- B. Indicating devices shall be at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device.
- C. Provide wiring troughs on both sides of terminal strips. Plastic wiring troughs shall have removable covers. Maximum fill for wiring troughs shall be 60%. All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 1 1/2 inches between terminal strip and wiring trough. All wiring labels shall be able to be read without removing wiring trough covers.
- D. Tubing and instruments containing water shall be in separate compartments located and constructed so that leakage or spray at 100 psi pressure cannot touch electrical conductors or devices. Leakage shall be conducted to the floor in duct or pipe.
- E. Provide wire-mesh cable tray for field wire management system across top of control panel.
- F. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal strips shall be located either at the bottom or on the side of the enclosure, depending on where the I/O conduits penetrate the enclosure. Wiring troughs shall be provided for all field wiring. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. All wiring shall be labeled at each end with corresponding numbers. This numbering shall be shown on the shop and record drawings.
- G. All door-mounted devices shall be furnished flush-mounted, and an exterior-engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided for each compartment, device, and light. All components within the enclosures shall be identified with interior-mounted engraved labels. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
- H. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.
- I. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals wired to terminal strips. Spares shall be provided for all voltage sources within the panel (e.g., 120 V, 24 V).
- J. Enclosures that include motor controllers shall have a main disconnect for the enclosure.

#### 1.11 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.

- B. All indicating and control devices mounted on control panels and standalone starter, enclosure doors (e.g., meters, gauges, electronic indicators, pilot lights, selector switches, OIPs, etc.) shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device.
- C. All motor control power shall be 120 volts with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- D. Devices powered at 120 volts from SCS panels shall be fused. This shall include, but not be limited to, solenoid valves, motor-operated valves, motorized ball valves, and transducers.
- E. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. 120-volt power shall be available at all control points. Lightning protection shall be completely solid-state and self-healing and shall not require the use of fuses. Provide a single switch with an indicating light to deenergize the control power for each location. Each panel shall have a GFI, duplex, 20 ampere, 120-volt receptacle.
- F. If enclosure and panel space is needed for future installation of devices and lights, the enclosure and panel shall be constructed for such installation. Supports shall be provided for future equipment, and panel openings shall be made and covered with neat cover plates matching the panel.
- G. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided, even though the detailed enumeration at various control points may omit listing that equipment.
- H. Where a certain accuracy of sensing and transmitting levels and controlling operations are called for, means must be provided to read or determine that the levels are within the limits or accuracy specified of the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of levels is necessary to set operating points, an indicating device of accuracy consistent with the operation of the system is required.
- I. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.

## 1.12 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the date established for Substantial Completion of the project.

## PART 2-PRODUCTS

### 2.01 INDUSTRIAL CONTROL AND POWER RELAYS

- A. Industrial control and power relays shall be installed in supervisory control centers, motor control centers, industrial control panels, and where required by System Supplier. Relays used to interface with PLC I/O shall be terminal style, interposing/isolation relays. Relays for motor control circuits, hardwired control logic, and for loads less than 10 amps shall be

general purpose, industrial, square base relays. Relays for lighting circuits and small motor loads shall be industrial, electrically held power relays.

- B. Relays shall meet the following requirements:
1. Interposing/isolation relays:
    - a. Configuration: SPDT or DPDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 Vac, or as required by System Supplier.
    - d. Contact rating: 8 A (DPDT), 16 A (SPDT).
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HK, or equal.
  2. General purpose relays:
    - a. Configuration: DPDT or 3PDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 Vac.
    - d. Contact rating: 15 A, minimum; 3/4 hp.
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
  3. Power relays:
    - a. Configuration: Electrically held, 2-12 poles.
    - b. Mounting: DIN rail, square base.
    - c. Voltage: 120 Vac.
    - d. Contact rating: 20 A continuous; 1 hp.
    - e. Operating life: 100 million cycles.
    - f. UL listed.
    - g. IEC (15 amps) or NEMA (20 amps) rated.
    - h. Manufacturer: Allen-Bradley, 700-CF for 15-amp loads and 700-PK for 20-amp loads, or equal.

## 2.02 PLC SUPERVISORY CONTROL SYSTEM (SCS) ENCLOSURES

- A. All control signals, status signals, alarm, and variable analog data shall be transmitted and received between the master data gathering site (at the WWTP) via OWNER's existing SCADA system. All PLC programming shall be provided by OWNER.
- B. It shall be the responsibility of System Supplier to ascertain that all field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:
1. Power levels.
  2. Power sources.
  3. Logic schemes.
  4. Signal types and levels.
  5. Interface devices where required.
  6. All other aspects of field devices impacting on the design of the system.

C. PLC Systems:

1. System Supplier shall provide all the equipment necessary for data gathering, monitoring, and control as required to meet this specification and in accordance with the drawings. The PLC system equipment shall include, but not necessarily be limited to, the following: PLC consisting of CPUs with adequate memory and instructions, local and remote I/O mounting racks, power supplies, I/O modules, communications modules and hardware, and all other components required to make the PLCs perform all the functions required in this specification. The PLCs shall be mounted in NEMA 12 enclosures as specified herein or as shown on the drawings; see Equipment Enclosures. The new PLC enclosures shall be completely assembled, prewired, and tested at System Supplier's factory. PLC programming shall be provided by OWNER.
2. Engineering:
  - a. System Supplier shall provide all engineering necessary to accomplish and document the requirements of this specification and in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:
    - (1) PLC system layouts.
    - (2) Panel layouts.
    - (3) I/O configuration and wiring drawings.
    - (4) Network layout.
  - b. Submittals: In addition to submittals previously described provide:
    - (1) Shop drawing and product data.
    - (2) Recommended spare parts lists.
  - c. Installation: CONTRACTOR shall install all system equipment including the PLC and local I/O enclosures, and interconnecting cabling as required.
3. The PLC shall be a microprocessor-based controller.
4. The PLC processor shall meet the following minimum general specifications:
  - a. Voltage: 85 to 265 volts AC.
  - b. Frequency: 47 to 63 Hz.
  - c. Temperature: 0 to 60°C.
  - d. Humidity: 5 to 95% noncondensing.
  - e. RFI: MIL-STD-461B.
  - f. EMI: IEEE 472-1974.
5. The PLC processor shall have the following minimum features:
  - a. 2 MB of battery-backed static RAM.
  - b. 1 GB of nonvolatile memory (Secure Digital).
  - c. Utilize 32-Bit architecture.
  - d. Solve 1K words of logic in 0.9 milliseconds.
  - e. I/O scan time of 0.225 milliseconds per I/O rack.
  - f. Real-time clock.
  - g. Selectable timed interrupts.
  - h. Local I/O capability of 16 modules.
  - i. Memory protection.
  - j. Two Ethernet/IP communications ports (up to 32 nodes) and one USB port for temporary use.
  - k. Remote I/O capability.
  - l. Status indicators.
6. The PLC must be capable of performing the necessary logic to control the system. PLC capabilities shall include, but not be limited to, the following:
  - a. Discrete I/O (120 Vac, isolated, or 24 Vdc with DC battery controller, as required).
  - b. Isolated analog input (4-20 mA).
  - c. Isolated analog output (4-20 mA).

- d. Timers.
  - e. Latch/unlatch relays.
  - f. Counters.
  - g. Comparators (setpoints for analog level).
  - h. Relay ladder logic.
7. The PLC must be capable of self-diagnosing the following error conditions resulting in orderly shutdown of the unit and annunciation of an error condition.
    - a. Memory parity error.
    - b. Loss of signal communication between master and I/O.
    - c. Loss of logic power.
    - d. Halt or interrupt of memory scan.
    - e. Detection of incomplete relay ladder rungs in memory.
  8. The PLCs shall be of the modular hardware style as manufactured by Allen-Bradley CompactLogix 5370 L3, catalog number 1769-L33ER, no equal, with all accessories required to perform the operations described herein. Firmware shall be RSLogix 5000, version 30.
  9. Environmental ratings for all components of the PLC system shall meet or exceed the following requirements:
    - a. Humidity rating of 0% to 95% relative humidity.
    - b. Ambient temperature rating 0° to 55°C.
  10. The vendor shall be able to attest that the PLC system has been designed and tested to operate in an industrial environment with all its associated electrical noise.
  11. All components comprising the PLC system shall be manufactured by a company regularly engaged in the manufacture of programmable controllers.
  12. The power supply shall be protected against short circuits.
  13. The power supply shall contain its own overcurrent and overvoltage protection.
  14. In the event of power loss, register or ladder information shall be retentive.
  15. To allow monitoring of a malfunctioning machine or process, it shall be possible to connect or disconnect programming equipment at all times, even when the system is running.
  16. The PLC enclosure shall include, but not be limited to, the following equipment:
    - a. Main PLC processor.
    - b. Dual power supplies separated by a communication/power isolation cable, Allen Bradley 1769-PA2 or 1769-PA4, as required.
    - c. I/O modules shall be isolated-type and have status LEDs.
    - d. Computer-grade transient and spike suppressor.
    - e. Rail mounted terminal blocks for field wiring terminations. Terminal blocks shall be as specified in Section 26 05 19–Wire.
    - f. Plastic wiring ducts sized for 20 percent spare capacity, minimum 1.5-inches by 3-inches.
    - g. General purpose duplex GFCI receptacle.
    - h. 20A, 120/240 VAC, circuit breakers for incoming lighting panel branch circuit wiring.
    - i. Other accessories required to provide a complete and working PLC system.
    - j. True on-line UPS backup for the SCS.
    - k. Relocated radio.
    - l. Network switch.
  17. The PLC processor shall be fed from dedicated 15 ampere circuit breakers through transient and spike suppressors.
- D. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for 3 years from startup.

- E. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.
  - 1. All wiring within the enclosure shall be through the plastic wiring ducts. All wiring not in ducts shall be in plastic spiral bindings. All I/O devices shall be wired to rail mounted terminal blocks.
  - 2. All field wiring shall terminate at the rail mounted terminal blocks that shall be mounted either at the bottom or on the side of the enclosure back panel depending on where the I/O conduits penetrate the enclosure.
  - 3. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired.
  - 4. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer.
  - 5. Self-drilling/tapping screws are not acceptable for mounting equipment within enclosures. All bolt holes shall be drilled and tapped.
  - 6. Provide all applicable finger-safe guards and covers.
  
- F. Refer to Section 26 05 53–Electrical Identification for the control panel and field wiring color code.
  
- G. 24-volt DC power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.
  
- H. Manufacturer of accessories (not previously specified):
  - 1. The plastic wiring duct shall be Electrovert "Electro-Duct," Panduit, or equal.
  - 2. Wire markers shall meet the requirements of Section 26 05 53–Electrical Identification.
  - 3. Circuit breakers shall be Allen Bradley 1606-XL, Bulletin 1489–M with the appropriate mounting rail.
  - 4. Power supplies shall be Allen Bradley, rail mount.
  - 5. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.
  
- I. Provide a 120-volt AC true on-line UPS backup in the SCS that will provide continuous power to the following equipment for at least 30 minutes following a power failure.
  - 1. UPS power shall be provided, at a minimum, to the following equipment:
    - a. PLC and I/O cards, controllers, and OIP.
    - b. Radio, network switch, signal converters, and other communication devices.
    - c. Power fail and communication indicating lights and alarm devices.
    - d. Power supplies for loop-powered instruments.
    - e. Intrusion detection system devices.
  - 2. The UPS and shall be plug connected inside the SCS with a dedicated receptacle and overcurrent protection device. All UPS-powered devices shall be continuously powered through the UPS under normal operating conditions. Provide relays to automatically bypass the UPS when the UPS output rises 110% above or falls 80% below the nominal supply voltage, or when the UPS is deenergized (e.g., line-side plug disconnected, upstream overcurrent device opened, etc.).
  - 3. Each UPS shall be provided with a relay card that provides a dry contact output to the SCADA System in the event that the UPS batteries need replacement.
  - 4. UPS shall be APC with relay I/O module, Liebert GXT5 with relay card, or Eaton 9SX. Provide a stand or shelf within each SCS panel for the UPS so that the UPS does not sit on the bottom of the enclosure and shall not cover or extend over control devices or terminal blocks.

## 2.03 FLOAT SWITCHES

- A. Station/building flooding alarms where called for shall be Siemens 101G, float switches, or equal.

## 2.04 LIMIT SWITCHES

- A. Limit switches (door switches) where called for on the drawings shall be GE Model 2507A for man doors. CONTRACTOR shall provide head and body style to fit application.
- B. Limit switches for sensing the position of swing arm check valves shall be Allen Bradley, Bulletin 802T, or equal. Switch shall include enclosure rated for the space installed, cat whisker sensor in length required for the application, and mounting hardware for check valve swing arm and flexible cable to junction box.

## 2.05 OPTICAL FLOAT SWITCH SYSTEM

- A. The floats shall use fiber optic cable to transmit a beam of light from a transmitter in the control panel to the float where the beam makes and breaks depending on the tilt of the float. The float shall have no electrical components or metallic wires that could cause arcs and sparks in an explosive environment. An optical receiver installed in the SCS shall detect the presence or absence of light and operate a relay in the receiver. The entire float system shall be by a single manufacturer. Provide float switch quantity as shown on the Drawings and all accessories required for a complete float switch system.
- B. The float switch shall be mercury and lead free and shall be made of recyclable materials. The float switch housing shall be polypropylene. the beam eclipser shall be stainless steel in an inert non-toxic dampening fluid that prevents chatter due to wave action. The viscosity of the fluid shall not change significantly over the range of -50°F to 155°F (-45°C to 70°C). the floats shall operate in liquid temperatures of 32°F to 130°F (0°C to 55°C). Floats shall be model OPTI-F160 by Cox Research, or equal.
- C. The transmitter and receiver shall be contained in a combination transceiver unit capable of connection to two floats each and be DIN-rail mounted. The transceivers shall operate in ambient temperatures of -15°F to 130°F (-25°C to 55°C). The transceivers shall operate at 12 VDC and shall be protected against accidental polarity reversal. The system shall operate in the visible and infrared light region with wavelengths between 400 nm and 1200 nm. The transceivers shall have a green LED power-on light and red LED lights on each channel indicating that the light beam is being received (float tilted up). The transceivers shall include one output relay for each connected float. Each relay shall be SPDT, rated 3A at 240 VAC, and capable of being connected normally open or normally closed. Transceivers shall be model MINI-TR3 by Cox Research, or equal. Provide power supplies in the SCS control panel as required by the float system manufacturer, model MINI-PS2 by Cox Research, or equal.
- D. The fiber optic cable shall be custom made for the float and shall consist of dual plastic fibers with an overall specialty blended PVC sheath for flexibility. The cable shall be connected and sealed at the float housing using a double seal method that will prevent water from entering the float even if the outer sheath is damaged. The cable shall be capable of splicing with tubular splices with cinch nuts on each end. Provide cable length as required to extend from the transceiver to the float without splicing.

- E. Provide mounting bracket model OPTI-UAB1 by Cox Research, or equal, and attachment hardware (two clips per float switch) model 3177T5 as manufactured by McMaster Carr, no equal, for fastening fiber optic float cable to mounting bracket.

## 2.06 OPERATOR INTERFACE PANEL

- A. The operator interface shall meet the following general specifications:
  - 1. Voltage: 85 to 264 Vac.
  - 2. Temperature: 0° to 55°C.
  - 3. Humidity: 5% to 95% noncondensing.
  - 4. RFI: MIL-STD-461B.
  - 5. EMI: IEEE 472-1974.
  - 6. Communication Port: CONTRACTOR shall coordinate.
- B. The operator interface shall have the following minimum features:
  - 1. Type: Color Active Matrix Thin Film Transistor (TFT) touchscreen with field replaceable backlight.
  - 2. Display Size: 6.5-inch.
  - 3. Resolution: 640 by 480 18-bit color graphics.
  - 4. Clock: Battery-backed real time.
  - 5. Application Memory: 512 MB.
  - 6. Enclosure: NEMA Type 12.
- C. The operator interface panel shall be as manufactured by Allen-Bradley, Panelview Plus 7, catalog number 2711P-T12W22A9P, no equal.

## 2.07 THERMOSTATS

- A. Thermostats associated with the SCADA System as specified in Section 26 09 90–SCADA System I/O Listing shall be provided by System Supplier as specified in Section 26 27 26–Wiring Devices. Thermostats shall be provided by System Supplier as specified in Section 26 27 26–Wiring Devices.

## 2.08 TVSS DEVICES FOR CONTROL PANELS AND INSTRUMENTATION EQUIPMENT

- A. Each incoming power supply in the SCS control panel shall be protected with a transient voltage surge suppression (TVSS) device. TVSS unit shall be as manufactured by Allen-Bradley Model 4983-DSX, or equal. Surge protection shall be provided for all phases and neutral.

## 2.09 INDUSTRIAL ETHERNET SWITCHES

- A. Unmanaged Ethernet switches shall be provided where shown on the drawings. Unmanaged switches shall be as manufactured by Allen Bradley Stratix 2000, no equal, and include copper ports as specified herein. Each switch shall include the following.
  - 1. Full/half-duplex operation.
  - 2. Auto-sensing speed and flow control and crossover cable connection.
  - 3. IEEE 802.3 compliance.
  - 4. Operating temperature: -40°C to 60°C.
  - 5. DIN rail mounting.
  - 6. Store and forward switching.
  - 7. Minimum of 8 copper ports.



## PART 3-EXECUTION

### 3.01 PUMP P-01 AND P-02 COMBINATION STARTERS

- A. Provide a NEMA size 1 FVNR starter in NEMA 12, wall-mount enclosure with 15-amp, three pole main circuit breaker disconnect. Provide red "Run", amber "Starter Overload", amber "Overtemperature", and amber "Seal Fail" pilot lights on the enclosure door. Also provide an elapsed time meter and reset pushbutton on the enclosure door. The enclosure shall be maximum 18 inches wide by 24 inches high by 8 inches deep. Provide terminal blocks for all remote signals being monitored at the pump station PLC as listed in the Section 26 09 90–SCADA System I/O Listing.
1. H-O-A selector switch:
    - a. With the H-O-A selector switch in the "Hand" position, the motor shall start and run continuously bypassing all controls, unless noted otherwise. Hand position shall be hard-wired not through the PLC.
    - b. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
    - c. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the hardwired float switches as follows:
      - (1) The pumps shall be controlled from the lead start (LS-02), lag start (LS-03), and the common off (LS-01) float switches. If the level falls below the low level alarm float switch (LSL-01), all running pumps shall shutdown and alarm shall be activated at the SCADA System. If the level rises to the high level alarm float switch (LSH-01) both pumps shall start and run, and an alarms hall be activated at the SCADA System. Provide an adjustable time delay so that the pumps do not start simultaneously.
  2. Motor has internal thermostats, which shall shut down the motor in the event of over-temperature (Hand and Auto modes). Manual reset shall be required to restart the motor. Motor also has internal moisture detection, which shall be for indication at the starter and SCADA only. This shall not shut down the motor. There is a 120 VAC control module (MiniCAS Unit) furnished as specified in Division 33 for thermal and moisture detection, which shall be installed in the starter by the CONTRACTOR. Provide control power transformer for control module as required.
  3. Each motor disconnect has auxiliary contacts that shall be wired to the starter such that control power is disconnected when the disconnect is in the Off position.
  4. All the above controls shall be hardwired and not through the PLC.

### 3.02 STATION CONTROL SYSTEM (SCS-THURBER) CONTROL PANELS AND GENERAL REQUIREMENTS

- A. The SCS panel (SCS-Thurber) shall be 30 inches wide by 12 inches deep, height as required, suitable for wall mounting. Provide a CompactLogix PLC, door-mounted Operator Interface Panel, and appurtenances as specified herein. This panel shall be used as a termination point for all transmitting and receiving equipment associated with each pumping station starter, and the standby power system. Refer to Section 26 09 90–SCADA System I/O Listing for all required I/O that shall interface with this SCS. A minimum of 10% spares shall be provided for each type of input and output used. All spare inputs and outputs shall be wired to terminal blocks.
- B. There shall be two circuits wired to the SCS panel to provide dedicated power to the following equipment.
1. Panel convenience outlet and light.
  2. SCS UPS, PLC, I/O devices, radio, OIP, network switch, and DC power supplies.

- C. The following hardware installed in the SCS panel shall be powered from the UPS through circuit breakers, Allen Bradley Model 1489-M, no equal.
  - 1. All SCS panel circuits, as specified above.
  - 2. PLC.
  - 3. Network switch.
  - 4. Radio power supply.
  - 5. SCS mounted OIP and programming-port receptacles.
  - 6. DC power supplies.
- D. Relocate the existing GE MDS SD9 radio from existing RTU panel. Provide power supplies as required.
- E. Provide 12-volt DC power supplies for the optical float switch transceivers, quantity as required, Cox Research Model MINI-PS2, no equal.
- F. The control panel shall have an exterior panel-mounted receptacle and programming port for the Ethernet network, mounted to the door of the panel. Receptacle and programming port shall be provided to allow for PLC, OIP, and radio programming via laptop without opening the panel door.
- G. Equipment controls and Operator Interface Panel programming will be provided by OWNER. CONTRACTOR shall coordinate I/O wiring and testing with OWNER as specified herein.
- H. The door switch (ZS-03) shall be monitored by the PLC for indication of building entry at the SCADA system.
- I. UPSs installed in all SCSs shall be configured to provide a dry contact output to the PLC in the event of a UPS common alarm. The common alarm shall include, but not be limited to, "UPS Fault" and "Replace Battery" alarms. Indication of a "UPS Common Alarm" shall be provided at the SCADA System for each UPS.
- J. Provide a control power fail relay in the SCS that shall be used to indicate an incoming control power fail alarm at the SCADA System. Provide a red indicating light on the front of each SCS to indicate a loss of incoming line power to the SCS. Control power fail wiring shall be hardwired and not through the PLC.
- K. Provide a 20 amp, two-pole contactor (one pole for status indication back to the PLC) in the SCS wired to field terminals for interface with the associated lighting panel circuit for control of the exterior light fixtures. Provide an On-Off-Auto selector switch on the front door of the SCS enclosure for control of the light fixtures as follows:
  - 1. With the O-O-A selector switch in the "On" position, the light fixtures shall be energized.
  - 2. With the O-O-A selector switch in the "Off" position, the light fixtures shall be deenergized.
  - 3. With the O-O-A selector switch in the "Auto" position, the light fixtures shall be controlled from the PLC.
- L. Provide a thermostat on the front door of the SCS wired to the PLC to activate a low building temperature alarm at SCADA system.

### 3.03 VOLTAGE MONITORING ENCLOSURE

- A. Provide a three-phase voltage monitor, Time Mark Model 269, or equal, in a NEMA 12, wall-mounted enclosure. Provide a fused disconnect for voltage sensing wiring from the ATS and terminal blocks for signal wiring to the SCS panel. Mount enclosure on the wall adjacent to the ATS.

END SECTION

**SCADA SYSTEM I/O LISTING**

STRAND ASSOCIATES, INC.  
 THURBER AVENUE PUMPING STATION REPLACEMENT  
 CONTRACT 9063  
 CITY OF MADISON, WISCONSIN  
 SCADA SYSTEM I/O LISTING - THURBER

ICS	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	CONTROL POWER FAIL		1	0	0	0	2~#14	FROM CONTROL POWER RELAY IN SCS
	UPS CONTROL POWER FAIL		1	0	0	0	2~#14	FROM UPS CONTROL POWER RELAY IN SCS
	REPLACE UPS BATTERY		1	0	0	0	2~#14	FROM UPS RELAY CARD IN SCS
	EXTERIOR LIGHTING ON/OFF		0	1	0	0	2~#14	TO LIGHTING CONTACTOR IN SCC
	EXTERIOR LIGHTING STATUS		1	0	0	0	2~#14	FROM LIGHTING CONTACTOR IN SCC
	BUILDING ENTRY	ZS-03	1	0	0	0	2~#14	FROM BUILDING DOOR SWITCH
	WET WELL LEVEL							
	HIGH LEVEL ALARM	LSH-01	1	0	0	0	2~#14	FROM OPTICAL RECEIVER IN THIS SCC
	LAG PUMP START	LS-03	1	0	0	0	2~#14	FROM OPTICAL RECEIVER IN THIS SCC
	LEAD PUMP START	LS-02	1	0	0	0	2~#14	FROM OPTICAL RECEIVER IN THIS SCC
	COMMON OFF	LS-01	1	0	0	0	2~#14	FROM OPTICAL RECEIVER IN THIS SCC
	LOW LEVEL ALARM	LSL-01	1	0	0	0	2~#14	FROM OPTICAL RECEIVER IN THIS SCC
	SUBMERSIBLE PUMP 1	P-01						
	IN AUTO		1	0	0	0	2~#14	FROM H-O-A SWITCH ON MOTOR STARTER
	RUNNING		1	0	0	0	2~#14	FROM MOTOR STARTER
	STARTER OVERLOAD		1	0	0	0	2~#14	FROM MOTOR STARTER
	START/STOP		0	1	0	0	2~#14	TO MOTOR STARTER
	SEAL FAIL		1	0	0	0	2~#14	FROM LEAKAGE SENSOR VIA MINI-CAS IN MOTOR STARTER
	MOTOR OVERTEMPERATURE		1	0	0	0	2~#14	FROM MOTOR THERMOSTATS VIA MINI-CAS IN MOTOR STARTER
	AMPS		0	0	X	0	ENET	FROM MOTOR STARTER
	KW		0	0	X	0	ENET	FROM MOTOR STARTER
	SUBMERSIBLE PUMP 2	P-02	5	1	X	0	ENET	SAME AS SP-01
	P-01 FLOW INDICATION	ZS-01	1	0	0	0	2~#14	FROM CHECK VALVE LIMIT SWITCH AT PUMP
	P-02 FLOW INDICATION	ZS-02	1	0	0	0	2~#14	FROM CHECK VALVE LIMIT SWITCH AT PUMP
	GENERATOR							
	RUNNING		1	0	0	0	2~#14	FROM GENERATOR
	FAILED		1	0	0	0	2~#14	FROM GENERATOR
	NOT IN AUTO		1	0	0	0	2~#14	FROM GENERATOR
	BATTERY CHARGER FAIL		1	0	0	0	2~#14	FROM GENERATOR
	AUTOMATIC TRANSFER SWITCH							
	ATS IN EMERGENCY (NORMAL SOURCE AVAILABLE)		1	0	0	0	2~#14	FROM AUTOMATIC TRANSFER SWITCH
	EMERGENCY SOURCE CONNECTED		1	0	0	0	2~#14	FROM AUTOMATIC TRANSFER SWITCH
	NOT IN AUTO		1	0	0	0	2~#14	FROM AUTOMATIC TRANSFER SWITCH

STRAND ASSOCIATES, INC.  
 THURBER AVENUE PUMPING STATION REPLACEMENT  
 CONTRACT 9063  
 CITY OF MADISON, WISCONSIN  
 SCADA SYSTEM I/O LISTING - THURBER

ICS	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
IRBER	FAILED TO TRANSFER		1	0	0	0	2-#14	FROM AUTOMATIC TRANSFER SWITCH
IRBER	INITIATE TEST (MAINTAINED)		0	1	0	0	2-#14	TO AUTOMATIC TRANSFER SWITCH
IRBER	ATS POWER FAIL		1	0	0	0	2-#14	FROM VOLTAGE MONITOR ON WALL
IRBER	BUILDING LOW TEMP ALARM		1	0	0	0	2-#14	FROM DOOR MOUNTED THERMOSTAT ON SCS
IRBER	BUILDING FLOODING	LS-04	1	0	0	0	2-#14	FROM BUILDING FLOODING SWITCH
	***TOTALS***		33	4	0	0		

SECTION 26 21 00

ELECTRICAL SERVICE SYSTEM

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Utility company.
  - 2. Primary service characteristics.
  - 3. Secondary service characteristics.
  - 4. Definitions.
  - 5. Underground electrical service.
- B. CONTRACTOR shall include in the Bid the cost of the following items specified in this Section. Refer to the individual sections listed below for a complete description of the Work required. Electric Utility Service Entrance, Section 1.05–Underground Electrical Service.
- C. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- D. See Division 01 for temporary service requirements. This section applies to permanent services only.

1.02 UTILITY COMPANY

- A. The Utility Company is Madison Gas and Electric.

1.03 SECONDARY SERVICE CHARACTERISTICS

- A. The secondary service will be 120/208-volt, 4-wire, three-phase for combined lighting and power.

1.04 DEFINITIONS

- A. Service: As defined in the NEC, Article 100.
- B. Primary Voltage: Above 600 volts.
- C. Secondary Voltage: 600 volts and below.

1.05 UNDERGROUND ELECTRICAL SERVICE

- A. Provide complete underground electrical service except for items provided by the Utility Company.
- B. Provide electrical service system, except the Utility Company will provide:
  - 1. Primary conduit and wiring from terminal pole to transformer.
  - 2. Duct from transformer to building.
  - 3. 75 KVA transformer and transformer pad.

4. Meter in CONTRACTOR-provided meter socket.
  5. All required easement coordination with the City.
  6. Primary cable as shown.
  7. Quad 4/0 AL secondary cable as shown from transformer to CONTRACTOR-provided main service circuit breaker disconnect. CONTRACTOR shall provide secondary conduit to intercept utility-provided conduit.
  8. Terminate secondary conductors on CONTRACTOR-provided main service circuit breaker disconnect.
- C. Coordinate the new electrical service with the Utility. No allowance will be provided for installation of the new service and costs shall be included in the Lump Sum Bid for the work provided by the Utility. All other costs for the electrical service shall also be included in the Lump Sum Bid.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION



## SECTION 26 24 16

### PANELBOARDS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Lighting and appliance panelboards.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of electrical equipment, cable, and wire products of the types and ratings necessary, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical equipment installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.
- E. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material, construction, and testing, where applicable.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

##### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All electrical equipment and material shall be received and stored with the factory tamperproof wrapping intact. Provide factory-wrapped waterproof flexible barrier material for factory packaging of equipment and material to protect against physical damage in transit. Do not install damaged equipment or material; remove from project site. Store equipment in factory coverings in a clean, dry, indoor space that provides protection against weather.

#### PART 2–PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Square D.

- B. Eaton.
- C. Substitutions: Under provisions of the General Conditions.
- D. The drawings and specifications were prepared based on Eaton. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

## 2.02 PANELBOARDS

- A. Lighting and appliance panelboards shall be provided as indicated on the drawings and as scheduled. Panelboards shall be factory-assembled and constructed in accordance with latest NEMA, UL, and NEC requirements and shall bear the UL label. Panelboard cabinets, including boxes and fronts, shall be code gauge galvanized steel. Front covers shall be hinged to allow access to wiring gutters without removal of panel trim (door-in-door type). All fronts shall be complete with cylinder-type lock and catch, and all cylinders shall be keyed alike. Provide two keys per panelboard to OWNER.
- B. Gutter and wiring space shall be provided according to NEMA and UL standards, except provide additional 6-inch-wide or -high wiring space for all double-lugged two or more section panels, feed-through panels; or panels that subfeed other panels at 100 amperes or more. CONTRACTOR shall instruct manufacturer as to where additional wiring space is needed, i.e., top, bottom, right, left, or combination. Where oversized cabinets are necessary for one section of a panelboard, all sections of the panelboard shall be the same size.
- C. Panelboards shall have full ampacity bussing throughout (full length of panel) and shall be full-size in regard to number of possible pole spaces. All lighting and appliance panels shall have poles as shown on the drawings. Power distribution panels shall have number of poles as scheduled or shown on the drawings. Panelboards shall be identified with phases reading left to right and circuits alternately numbered left to right, odd numbers on the left, even numbers on the right.
- D. Panelboards shall have copper bussing. Provide copper ground bus in all panelboards.
- E. Lugs for incoming feeders shall be UL listed for use with copper conductors. Lugs shall be sized by CONTRACTOR in accordance with feeder sizes shown. Main lugs or main breakers shall be top- or bottom-mounted to coordinate with incoming feeder entrance location. Location shall be selected by CONTRACTOR.
- F. Branch circuit breakers shall be quick-make, quick-break, with thermal magnetic trip bolt-on type. Multipole breakers shall have common internal trip, UL listed as multipole units; handle ties are not permitted. All breakers shall be of the same manufacturer as the panelboard and provided at ampere capacity as scheduled.
- G. Lighting and Appliance Panelboards shall be provided as follows (types listed are Cutler-Hammer):

Type	Maximum Voltage	Maximum Bus Amps	Maximum Brk. Amps	Minimum I.C.
Pow R-Line 1a	240	400	100	10,000

- H. All panelboards scheduled with main circuit breakers shall be individually mounted main circuit breaker panels. Main circuit breakers installed in the location of branch circuit devices (branch-mounted mains) are not acceptable.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Panelboards shall be provided as indicated. Final locations, sizes, and mounting of panelboards shall be reviewed with ENGINEER prior to installation.
- B. Each panelboard shall have a typewritten circuit schedule provided on the inside cover. This schedule shall be covered with clear plastic in a metal frame and shall include room numbers, room name, and area or item served by each branch circuit. Room numbers used shall be those used by OWNER, except as otherwise requested by ENGINEER.
- C. Prior to final inspection, clean all panelboard interiors, adjust trims, covers, hinges and locks, and refinish covers to original condition.
- D. Panel trim shall have enamel finish as selected by OWNER.
- E. Balance load on all panelboards so phases are balanced to 15% of each other. Reconnect or redistribute circuits and/or circuit breakers to achieve balanced condition. Submit ammeter readings for all panelboard feeders indicating normal operating load and phase balance.

END OF SECTION

SECTION 26 24 19

MOTOR CONTROL

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Motor control devices, accessories, and general requirements.
  - 2. Manual motor starters.
  - 3. Magnetic motor starters.
  
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

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1.02 REFERENCES

- A. ANSI/NEMA ICS 6-Enclosures for Industrial Controls and Systems.
  
- B. NEMA AB 1-Molded Case Circuit Breakers.
  
- C. NEMA ICS 2-Industrial Control Devices, Controllers, and Assemblies.
  
- D. NEMA ICS-18-Motor Control Centers.
  
- E. NEMA KS 1-Enclosed Switches.
  
- F. NEMA PB 1-Panelboards.
  
- G. NEMA PB 1.1-Instruction for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

### 1.03 QUALITY ASSURANCE

- A. Manufacturers of Motor Control Equipment: Firms regularly engage in the manufacture of motor control equipment of the types and capacities required whose products have been in satisfactory use in similar service for not less than 10 years.
- B. UL Labels: Provide motor control devices, manual motor controllers, magnetic motor starters, solid-state starters, variable frequency drives, combination motor starters, motor control centers, etc., which have been listed and labeled by Underwriters Laboratories.

### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Provide product data on motor starters and combination motor starters, VFDs, relays, pilot devices, and switching and overcurrent protective devices.

### 1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

### 1.06 DELIVERY, STORAGE, AND HOLDING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

### 1.07 COORDINATION

- A. To provide proper coordination between Section 26 09 00–Controls and Instrumentation, and equipment specified herein, all equipment specified in this section shall be supplied as part of the Controls and Instrumentation package described in Section 26 09 00. This shall include, but not be limited to, equipment such as stand-alone motor controllers, combination starters, and control stations. Drawings for combination starters, motor controllers, and motor control equipment shall be provided by the Section 26 09 00 System Supplier. Drawings from equipment manufacturers will not be accepted as shop drawings or O&M documents.

### 1.08 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the date established for Substantial Completion of the project.

## PART 2-PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Motor control devices and motor starters shall be as manufactured by Allen-Bradley, or equal, as approved by ENGINEER and in accordance with substitutions under provisions of the General Conditions. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer.
- B. The drawings and specifications were prepared based on Allen-Bradley. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

### 2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

- A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.
- B. Push buttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as shown on the drawings.
- C. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as shown on the drawings.
- D. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as shown on the drawings.
- E. Timing Relays: UL listed with On and Timing-Out LEDs.
- F. Contactors: NEMA ICS 2. All contactors for starters specified herein, including VFD and bypass starters, shall be NEMA rated. IEC contactors are not allowed. Contactors shall be Allen-Bradley, Bulletin 509, or equal.
- G. Control Power Transformers: 240/120-volt secondary. Each motor starter shall have a dedicated control power transformer.
- H. Elapsed Time Meters: Redington/Engler 722 series, or equal, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.
- I. Relays for motor control circuits, hard-wired control logic, and for loads less than 10 amps shall be general purpose, industrial, square base relays. Relays for lighting circuits and small motor loads shall be industrial, electrically-held power relays. Relays shall meet the following requirements:
  - 1. General purpose relays:
    - a. Configuration: DPDT or 3 PDT as required by system supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 Vac.
    - d. Contact rating: 15 A, minimum; 3/4 hp.
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag type or LED indicator.

- g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
  - 2. Power relays.
    - a. Configuration: Electrically-held, 2-12 poles.
    - b. Mounting: DIN rail, square base.
    - c. Voltage: 120 Vac.
    - d. Contact rating: 20 A continuous; 1 hp.
    - e. Operating life: 10 million cycles.
    - f. UL listed.
    - g. NEMA rated.
    - h. Manufacturer: Allen-Bradley, 700-PK, or equal.
  - 3. All timing relays shall have on and timing our LEDs.
- J. All starters shall be equipped with the auxiliary devices to meet the requirements of the Drawings and Specifications. Each starter operating at other than 120-volt, single-phase shall be equipped with a control transformer providing 120-volt secondary for control power. Transformer shall have fused primary and secondary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all starters shall be 120 volts.
- K. Enclosures for Starters and Control Devices:
- 1. Enclosures in indoor dry locations shall be NEMA 1 gasketed.
  - 2. Starters and disconnect devices for motors shall be installed in common enclosures, combination type, with all accessories such as terminal blocks, push-to-test pilot lights, and H-O-A switches.
  - 3. All wiring within starter enclosures shall be landed on terminal blocks. This shall include internal control wiring, field wiring, and any spare or unused wiring.
  - 4. Enclosures shall include devices as shown on the Drawings and specified in Section 26 09 00–Controls and Instrumentation.
- L. Hardwired Motor Controls:
- 1. Equipment and wiring specified to be hardwired shall be physically wired independent of controllers, programmable relays, and communication systems to allow manual operation in the event of an emergency.
  - 2. Motor control wiring and logic shall be set up such that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart equipment following a power failure.

## 2.03 MANUAL MOTOR CONTROLLERS

- A. Where noted on the drawings, controllers for motors rated 2 hp or less, for operation at 120 V or 240 V single-phase, shall be specification grade wall switches as specified in Section 26 27 26–Wiring Devices.

## 2.04 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a solid-state overload relay consisting of the following:
  - 1. Sensing Module: Allen-Bradley E300, Bulletin 592-ESM, or equal. Provide mounting option as required.

2. Control Module: Allen-Bradley E300, Bulletin 193-EIO, or equal. Control module shall have integrated I/O (four inputs and four outputs) and a rated control voltage of 120-volts AC, unless otherwise noted.
  3. Communication Modules: Allen-Bradley E300, Bulletin 193-ECM, or equal. Communication module shall have two Ethernet/IP ports for communication with the SCADA System.
  4. Expansion Modules: Allen-Bradley E300, Bulletin 193-EXP, or equal. Provide expansion modules as required.
  5. Starters for motors installed outdoors shall include ground fault protection.
- B. Full-Voltage Starting: Reversing or nonreversing type as shown on the drawings.
- C. Coil Operating Voltage: 120 volts, 60 Hz.
- D. Size: NEMA ICS 2; size as shown on the drawings. Contactors shall be Allen-Bradley, Bulletin 505 (Nonreversing), or Bulletin 509 (Nonreversing), or equal. Contractors for motor-operated valve actuators shall be All-Bradley, Bulletin 305, or equal.
- E. Overload relays shall have the following features: Network connectivity status indicators.
- F. Magnetic motor starters in combination motor starters or control panels shall be combined with thermal magnetic molded case circuit breakers.
- G. Through-the-door overload reset pushbuttons shall be provided for all magnetic starters installed in combination motor starters.

## 2.05 COMBINATION MOTOR STARTERS

- A. Magnetic motor starters shall be individually mounted as specified herein or noted on the drawings. Overloads specified herein shall be combined with molded case circuit breakers, and enclosure type shall be as specified herein or noted on the drawings. Control devices and starter components shall be provided as specified herein or noted on the drawings.
- B. All combination starters shall be factory assembled, wired, and tested. All internal wiring shall be color-coded and numbered, and each wire shall be terminated on terminal strips. Schematic and wiring layout drawings, following JIC Standards, which show all connections to external devices, a complete bill of materials, and a detailed description of operation shall be submitted for each piece of equipment.
- C. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.
- D. Combination starters shall be Allen-Bradley, Bulletin 513, or Square D.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Provide motor control equipment in accordance with manufacturer's instructions and drawings.



- B. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the drawings is not acceptable. Where power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current because of improved power factor.
- C. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.
- D. Motor Data: Provide neatly typed label inside each motor starter enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.
- E. Control, power, and field wiring within starter enclosures shall be separated from communication cables. Where possible, route control, power, and field wiring in raceways or wireways separated from communication cables. Provide a minimum of 2 inches separation between control, power, and field wiring communication cables.
- F. All motors will be provided by other divisions, ready for connections. CONTRACTOR shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.
- G. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, disconnect switches, etc.
- H. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits, as specified in Section 26 05 19–Wire.
- I. Provide motor starters as specified for all motors, unless shown or specified that starters or control equipment will be furnished by others.
- J. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

END OF SECTION

## SECTION 26 27 16

### HINGED-COVER ENCLOSURES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Hinged cover enclosures.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

##### 1.02 REFERENCES

- A. NEMA 250–Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. ANSI/NEMA ICS 1–Industrial Control and Systems.
- C. ANSI/NEMA ICS 6–Enclosures for Industrial Control Equipment and Systems.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

#### PART 2–PRODUCTS

##### 2.01 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, larger than 12 inches in any dimension. Acceptable manufacturers: Hoffman, B-Line, or equal.
- B. Covers: Continuous hinge, applicable NEMA (NEMA 12 only) or clamps (NEMA 4X only) rating with 90-degree, rotating handle and 3-point latch or recessed quarter-turn latches and hasp and staple for padlock.
- C. Back Panel for Mounting Terminal Blocks or Electrical Components: 14 gauge steel, white enamel finish.
- D. All enclosures with double doors or that are free-standing shall have a 3-point latch.

##### 2.02 FABRICATION

- A. Shop-assembled enclosures housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
- B. Provide conduit hubs on all enclosures.

- C. Provide protective pockets inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.
- D. Provide gasketed surfaces for all enclosure doors and covers.

### 2.03 ENCLOSURE RATING

- A. Enclosures shall be rated as listed below, unless noted otherwise on the Drawings:
  - 1. Indoor dry locations: NEMA 12, steel.
  - 2. Outdoor, corrosive, or wet locations: NEMA 4X, 316 stainless steel.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install enclosures plumb. Anchor securely to wall and structural supports at each corner minimum.
- B. Refer to Section 26 05 53-Electrical Identification for enclosure labeling requirements.
- C. Provide accessory feet for free-standing equipment enclosures.
- D. All enclosures attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion. All enclosures in damp locations shall be on 1/2-inch standoffs. Damp locations shall include, but not be limited to, all basement areas, tunnel areas, washdown areas, garage areas, all wet wells and dry wells, all areas below grade, and exterior locations.

END OF SECTION

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Wall switches.
  - 2. Receptacles.
  - 3. Cover plates.
  - 4. Thermostats.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NEMA WD 1-General-Color Requirements for Wiring Devices.
- B. NEMA WD 5-Specific-Purpose Wiring Devices.
- C. Drawings-Bill of Materials.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00-Submittals.
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

## PART 2--PRODUCTS

### 2.01 WALL SWITCHES

- A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Hubell 1221I, 1222I, 1223I, or equal.
- B. Class I Switches: AC general use snap switch, 20 amperes, front operated Crouse-Hinds EDS, or equal.
- C. Provide ivory-colored handles.
- D. Manual motor controllers for 120 V or 240 V motors on circuits 20 amps or less shall be specification grade snap switch as specified above.

### 2.02 RECEPTACLES

- A. Twenty ampere, 125-volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Hubbel 5362I, or equal. Provide ivory color.
- B. GFCI Receptacle: GFCI receptacles shall be UL 943 listed, Hubbel GFR53625GC receptacle with integral ground fault current interrupter. Provide ivory color.

### 2.03 COVER PLATES

- A. Each and every flush box shall be provided with standard 302 series stainless steel plates, blank, receptacle, switch, or cord as designated by outlet symbol. Cover plates in dry locations shall be Appleton Model FSK-1DR or FSK-ITS. Cover plates in damp locations shall be Appleton Model FSK-1VDR or FSK-1US.
- B. Exterior receptacles shall have Thomas & Betts Model CKMUV metal, weatherproof cover, no equal.
- C. Cover plates for manual motor switches and NEC required equipment disconnects shall have provisions for locking the switch in the On or Off position. Cover plates for single phase motor switches shall be Appleton Model FDK-1US.

### 2.04 THERMOSTATS

- A. Line voltage thermostats for single-stage heating or single-stage cooling, and for high- and low-temperature alarms shall be PECO Model TF115-001, or equal. Thermostats shall be rated NEMA 4X with a 40°F to 110°F temperature range and fixed 3°F deadband.
- B. Thermostats shown on the drawings shall be single-stage unless otherwise noted.

## PART 3--EXECUTION

### 3.01 INSTALLATION

- A. All receptacles shall be mounted vertically.

- B. GFCI receptacles shall not be series wired.
- C. Install wall dimmers 48 inches above floor (top of box); derate ganged dimmers as instructed by manufacturer; do not use common neutral.
- D. Install convenience receptacles 15 inches above floor (bottom of box), grounding pole on bottom except as otherwise noted.
- E. Install specific-use receptacles at heights shown on the Drawings.
- F. Convenience Receptacles: Specification grade self-grounding.
- G. Install devices and cover plates flush and level.
- H. Back wiring is not allowed for switches and receptacles. Wires shall be terminated with the device screw terminal.
- I. Individual labels shall be placed on the back of all switch faceplates and receptacle faceplates indicating the lighting panel and circuit from which the switch or receptacle is fed. Labels shall be White background with Black lettering no smaller than 12-point font. Provide permanently attached self-adhesive type, machine fed, and self-laminating labels, or equal. All labels must be by the same manufacturer, same size, and same font. Handwritten labels are not acceptable.

END OF SECTION

## SECTION 26 28 00

### OVERCURRENT PROTECTIVE DEVICES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Provide overcurrent protective devices as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop Drawings and product data in accordance with provisions of Section 01 33 00–Submittals, including electrical ratings, physical size, interrupt ratings, trip curves, I<sup>2</sup>t curves, and manufacturer's detailed specifications.

##### 1.03 QUALITY ASSURANCE

- A. Comply with the following requirements:
  - 1. NFPA 70 National Electrical Code (NEC).
  - 2. Local codes and ordinances.
  - 3. Provide overcurrent protective devices by same manufacturer for each type of device.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Section 01 60 00–Materials and Equipment.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

#### PART 2–PRODUCTS

##### 2.01 CIRCUIT BREAKERS

- A. General:
  - 1. Comply with UL 489 and NEMA AB1 requirements.
  - 2. Provide thermal and magnetic protection unless noted otherwise.
- B. Main Service Circuit Breaker Disconnect:
  - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
  - 2. The circuit breaker enclosure assembly shall be service-entrance rated.
- C. All lugs shall be rated to accept both copper and aluminum conductors.

## 2.02 ENCLOSURES

- A. Circuit breakers shall be installed as shown on the Drawings.
- B. Provide circuit breaker with enclosures where required as listed below, unless noted otherwise on the Drawings: Outdoor, corrosive, or wet location: NEMA 4X, stainless steel.

## 2.03 ACCESSORIES

- A. Provide accessories as scheduled as listed below:
  - 1. Handle lock: Include provisions for padlocking.
  - 2. Provide mechanical trip device.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install overcurrent protective devices in accordance with manufacturer's recommendations.

END OF SECTION



## SECTION 26 28 16

### DISCONNECT SWITCHES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Disconnect switches.
  - 2. Fractional hp motor switches.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NEMA KS 1–Enclosed Switches.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

#### PART 2–PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Disconnect Switches: Square D Class 3110.
- B. Manual Motor Switches: Square D Class 2510 Type K Allen-Bradley.
- C. Substitutions: Under provisions of the General Conditions.

##### 2.02 DISCONNECT SWITCHES

- A. Nonfusible Disconnect Switches: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle lockable in “Off” position. Provide auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.

## 2.03 SINGLE-PHASE MOTOR SWITCHES (2 HP OR LESS)

- A. Where noted on the drawings, motors rated 2 hp or less, for operation on 120 V or 240 V, single-phase, shall be provided with a specification-grade wall switch as disconnecting means. See Section 26 27 26–Wiring Devices for additional information.

## 2.04 ENCLOSURES

- A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the drawings:
  - 1. Indoor dry locations: NEMA 12, steel.
  - 2. Outdoor, corrosive, or wet locations: NEMA 4X, stainless steel.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Provide disconnect switches where indicated on the drawings. Maximum mounting height shall be 42 inches above finished floor unless noted otherwise, or acceptable to ENGINEER based on field conditions.
- B. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring (e.g., MAS units, space heaters) shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the "Off" position.
- C. Wiring within disconnects shall only be for loads or equipment served by that disconnect. Foreign wiring within disconnect enclosures is not allowed. All wiring within disconnect enclosures shall be landed on lugs or terminals provided by the disconnect manufacturer, or on dedicated terminal strips for instrumentation equipment or field devices. Splices and spring wire connectors are not allowed within disconnect enclosures.

END OF SECTION

## SECTION 26 32 13

### STANDBY POWER SYSTEM

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Steel base assembly, natural gas, engine, generator, engine-generator set controls, environmental systems.
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 01 shall govern work in this section.
  - 2. The following listing of related sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this work. All other sections of Division 26.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop drawings shall include the following:
  - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
  - 2. Detailed layouts of all equipment and ancillary items.
  - 3. The manufacturer shall furnish schematic and wiring diagrams for the generator and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

##### 1.03 QUALITY ASSURANCE

- A. The generator shall be listed by Underwriters Laboratories, Inc., and be certified by the Canadian Standards Association.

##### 1.04 OPERATING CONDITIONS

- A. Engine-generator set shall be capable of continuous standby rating at 1,800 rpm, 0.8 PF, three-phase, 4-wire, 208 volts, at 60 hertz, and shall have a minimum capability of 20 kW, 25 kVA standby. The unit shall be capable of 26 surge kW, 48 kVA for motor starting at a maximum sustained voltage dip of 10%.
- B. The generator set manufacturer shall verify the engine as capable of driving the generator with all accessories in place and operating, at the generator set kW rating after derating for the range of temperature expected in service, and the altitude of the installation. Site conditions are 100°F maximum ambient and 900 feet altitude.
- C. Voltage regulation shall be  $\pm 0.5\%$  of rated voltage for any constant load between no load and rated load.

- D. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed  $\pm 0.5\%$ .
- E. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed  $\pm 0.5\%$  of rated voltage for constant loads from no load to rated load, with constant ambient and operating temperature.
- F. Total Harmonic Distortion: The sum of AC voltage wave-form harmonics from no load to full linear load shall not exceed 5% of rated voltage (L-N, L-L, L-L-L), and no single harmonic shall exceed 3% of rated voltage.
- G. Telephone Influence Factor: TIF shall be less than 50 per NEMA MG1-22.43.
- H. The engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- I. Motor starting capability shall be a minimum of 48 kVA. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 25%.

#### 1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the date established for Substantial Completion of the project.

### PART 2-PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. The AC engine-generator set shall be as manufactured by Cummins Power Generation Model C20N6.
- B. The drawings and specifications were prepared based on Cummins Power Generation. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

#### 2.02 ENGINE

- A. The engine shall be stationary, liquid-cooled. The design shall be 4-cycle, 4-cylinder, minimum displacement of 143.5 cubic inches, turbo charged, after cooled as required by engine manufacturer. Engine shall be certified as capable of driving the generator of the rating indicated above on a continuous standby basis for the duration of normal source interruptions.

- B. Engine accessories shall include the following:
1. A 12-volt DC electric starter as required by the engine manufacturer.
  2. Replaceable dry element air cleaner with restriction indicator.
  3. Positive displacement, mechanical, full-pressure lubrication oil pump, full-flow lubrication oil filters with replaceable elements, pressure relief valve, dipstick oil level indicator, and oil drain valve with hose extension. Provide all lubricants for proper operation of the unit.
  4. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, and accelerating to rated speed. The governing system shall include a programmable warm-up at idle and cool-down at idle function. While operating in idle state, the control system shall disable the alternator excitation system.
  5. Engine protective devices to indicate alarm and engine shutdown for the following:
    - a. Low coolant temperature alarm.
    - b. Low coolant level alarm.
    - c. Low lubrication oil pressure alarm and shutdown.
    - d. High coolant temperature alarm and shutdown.
    - e. Over-speed shutdown.
    - f. Over-crank shutdown.
  6. Battery charging alternator, 50 amp minimum, with solid-state voltage regulator.
  7. Engine shall be radiator-cooled by engine-mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Rotating parts shall be guarded against accidental contact. The cooling system shall be rated for full-rated load operation in a 104°F ambient condition. Radiator shall be provided with a duct adaptor flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall. Provide radiator drain extension to the side of the generator. Extension shall include shutoff valve.
  8. Provide engine-mounted heat exchangers for use with water cooling. Cooling systems shall be rated for full-load operation. Heat exchangers shall be sized based on a water temperature of 65°F or higher. The generator manufacturer shall fill the cooling system with a 50/50 ethylene glycol/water mixture. Furnish two water solenoids (one for each heat exchanger) to open when the generator receives a start signal. Solenoid valves shall be installed by CONTRACTOR. Furnish a thermostatic control valve/water saver for installation by CONTRACTOR. CONTRACTOR shall provide flexible connections to heat exchangers.
  9. The equipment supplier shall provide 50% ethylene glycol antifreeze solution to fill engine cooling system.
  10. Engine-mounted thermostatically controlled coolant heater to aid in quick starting. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104°F in a 40°F ambient, in compliance with NFPA 110 requirements. Heater shall be rated single-phase, 120 volts, 1,000 watts and be disconnected whenever the engine starts. Heater shall be UL 499 listed and labeled. The coolant heater(s) shall include provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. CONTRACTOR shall provide proper circuit from normal utility power source.
  11. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.

12. Flexible fuel lines, fuel strainer, and fuel solenoid. CONTRACTOR shall install fuel lines and fuel solenoid per manufacturer's recommendations.
13. The engine shall be provided with all fuel system piping required for automatic operation of the system. All natural gas piping and valves shall be as follows:
  - a. All natural gas piping shall be provided and tested in accordance with all state, local, and utility codes pertaining to natural gas service or service requirements. CONTRACTOR shall arrange for natural gas service with Wisconsin Public Service, shall coordinate service size and location, and shall furnish and install all shutoff valves and pressure reduction as required.
  - b. Natural gas piping (3 inches in diameter and larger) shall be Schedule 40 black steel pipe (ASTM A53 with flanges conforming to ASTM A181, Grade I, 150-pound forged steel flanged joints). Natural gas piping (smaller than 3 inches) shall be Schedule 40 black steel pipe (ASTM A53 with 150 psi steel weld fittings or 150 psi malleable iron screw fittings). Gas piping 1 1/2 inch and larger, aboveground, may be welded. Piping 1 1/4 inch and smaller shall be screwed.
  - c. Joints for screw pipe shall be made by cutting pipe square and reaming inside. Pipe shall extend to shoulder of fitting with clean cut taper threads. Joint compound shall be red lead. Seamless welding fittings shall be used for all welded piping.
  - d. Shutoff valves in all natural gas lines 1/2 inch through 4 inch shall be DeZurik, Series 400, or equal, lever-operator, complete with Figure 425, or equal Buna N steam seal and Hycar-type plug and accessories suitable for natural gas service.

### 2.03 ENGINE EXHAUST SYSTEM

- A. Engine emissions shall meet current 2009 Environmental Protection Agency (EPA) NSPS gas engine emission regulations. Engines shall be EPA-certified and emission approval documentation shall be provided to OWNER prior to final completion. All costs associated with any on-site EPA-required emissions testing shall be included in the Bid.
- B. Exhaust muffler shall be provided for the engine of size as recommended by manufacturer. Muffler shall be of the critical grade-type.
- C. Stainless steel flexible exhaust connections shall be provided as required for connection between engine exhaust manifold and exhaust line in compliance with applicable codes and regulations.
- D. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation to prevent condensation from entering the engine.

### 2.04 STARTING AND CONTROL BATTERIES

- A. A UL-listed/CSA-certified 10-ampere voltage regulated battery charger shall be provided for the engine-generator set.
- B. Charger shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.
- C. The charger shall be compliant with UL 991 requirements for vibration resistance.
- D. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL labeled with the maximum battery amp-hour rating

that can be recharged within 24 hours. The label shall indicate that the charger is suitable for charging of 200 AH batteries in accordance with NFPA requirements.

- E. The charger shall incorporate a 4-rate charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100% of charge, and a float stage to maintain a fully charged battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.
- F. The DC output voltage regulation shall be within  $\pm 1\%$ . The DC output ripple current shall not exceed 1 amp at rated output current level.
- G. The charger shall include the following features:
  - 1. Two-line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming.
  - 2. LED indicating lamps to indicate normal charging (green), equalize charge state (amber), and fault condition (red).
  - 3. AC input overcurrent, over voltage, and under voltage protection.
  - 4. DC output overcurrent protection.
  - 5. Alarm output relay.
  - 6. Corrosive-resistant aluminum enclosure.
- H. A calcium/lead antimony storage battery set of the heavy-duty starting-type shall be provided. Battery voltage shall be compatible with starting system. The battery set shall be rated no less than 550 CCA and shall be capable of a minimum of three 15-second cranking cycles. A battery rack constructed in conformance with NEC requirements and necessary cables and clamps shall be provided.

## 2.05 GENERATOR

- A. The generator shall be a single prelubricated regreasable bearing, self-aligning, 4-pole, two-thirds pitch, brushless, synchronous-type, revolving field with amortisseur windings, and with direct driven centrifugal blower fan for proper cooling and minimum noise. No brushes will be allowed. Generator shall be directly connected to engine fly wheel housing and driven through a flexible coupling to provide permanent alignment. Generator design shall prevent potentially damaging shaft currents.
- B. Insulation shall meet NEMA standards for Class H and shall be UL 1446 listed. The maximum temperature rise shall not exceed 125°C at 40°C ambient.
- C. The generator shall be three-phase, broad-range, reconnectable and shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
- D. The generator set shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5% above or below rated voltage.
- E. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single-phase or three-phase fault at approximately 300% of rated current for not more than 10 seconds.

- F. The subtransient reactance of the alternator shall not exceed 15%, based on the standby rating of the generator set.
- G. Provide a 70-amp mainline circuit breaker with the engine-generator set. Circuit breaker shall meet the requirements specified in Section 26 28 00—Overcurrent Protection.

## 2.06 ENGINE-GENERATOR SET CONTROL

- A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- B. The generator set mounted controls shall include the following features and functions:  
Control Switches:
  - 1. Mode Select Switch: The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
  - 2. EMERGENCY STOP switch: Switch shall be Red "mushroom-head" pushbutton. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
  - 3. RESET switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
  - 4. PANEL LAMP switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
- C. Generator Set AC Output Metering: The generator set shall be provided with a metering set including the following features and functions:
  - 1. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current (all three phases), frequency, output current, output kW, kWh, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
  - 2. The control system shall log total number of operating hours and total kWh, as well as total values since reset.
- D. Generator Set Alarm and Status Display:
  - 1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
    - a. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
    - b. The control shall include a flashing red lamp to indicate that the control is not in automatic state and red common shutdown lamp.
    - c. The control shall include an amber common warning indication lamp.



2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:
    - a. Low oil pressure (warning).
    - b. Low oil pressure (shutdown).
    - c. Oil pressure sensor failure (warning).
    - d. Low coolant temperature (warning).
    - e. High coolant temperature (warning).
    - f. High coolant temperature (shutdown).
    - g. High oil temperature (warning).
    - h. Engine temperature sensor failure (warning).
    - i. Low coolant level (warning).
    - j. Fail to crank (shutdown).
    - k. Fail to start/overcrank (shutdown).
    - l. Overspeed (shutdown).
    - m. Low DC voltage (warning).
    - n. High DC voltage (warning).
    - o. Weak battery (warning).
    - p. High AC voltage (shutdown).
    - q. Low AC voltage (shutdown).
    - r. Under frequency (shutdown).
    - s. Overcurrent (warning).
    - t. Overcurrent (shutdown).
    - u. Short circuit (shutdown).
    - v. Overload (warning).
    - w. Emergency stop (shutdown).
    - x. (4) configurable conditions.
  3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. All contacts shall be rated for 5 amps at 120 Vac. Relays shall be provided when necessary. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The nonautomatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
- E. Engine Status Monitoring:
1. The following information shall be available from a digital status panel on the generator set control:
    - a. Engine oil pressure (psi or kPA).
    - b. Engine coolant temperature (degrees F or C).
    - c. Engine oil temperature (degrees F or C).
    - d. Engine speed (rpm).
    - e. Number of hours of operation (hours).
    - f. Number of start attempts.
    - g. Battery voltage (DC volts).
  2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set.
- F. Engine Control Functions:
1. The control system provided shall include a cycle cranking system which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for three cranking periods of 15 seconds each, with 15-second rest period between cranking periods.

2. Manual Run/Stop Control Switch: When the mode control switch is in the MANUAL position and the MANUAL RUN/STOP switch is pressed, the Generator set shall start, bypassing time delay start. The control shall be configurable to include an idle period on manual start. If the generator set is running in the MANUAL mode, pressing the RUN/STOP switch shall cause the generator set to shut down after a cool-down at idle period.
3. The control system shall include an engine governor control which functions to provide steady state frequency regulation, as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
4. The control system shall include sensor failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sensor or wiring components, and an actual failure conditions.

G. Alternator Control Functions:

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
2. A microprocessor-based protection device shall be provided to individually monitor all phases of the output current of the generator set and initiate an alarm (overcurrent warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The device shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (overcurrent shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
3. A microprocessor-based protection device shall be provided to monitor all phases of the output current for short-circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (short-circuit shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
4. Controls shall be provided to monitor the kW load on the generator set and initiate an alarm condition (overload) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
5. A microprocessor-based AC over and undervoltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Undervoltage shutdown shall occur when the output voltage of

the alternator is less than 85% for more than 10 seconds. The system shall monitor individual phases and be connected line to neutral on three-phase 4-wire generator sets and for systems that are solidly grounded.

- H. Provide dry contacts for monitoring each of the following signals at the SCADA System:
  - 1. Generator Running.
  - 2. Generator Failed.
  - 3. Generator Not-in-Auto.
- I. Auxiliary generator running contacts shall also be provided for remote indication at the SCADA System and to open the intake and exhaust dampers. All contacts shall be rated for 5 amps at 120 Vac.

## 2.07 WEATHER-PROTECTIVE GENERATOR ENCLOSURE

- A. Generator set weather-protective housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electrocoating paint process, or equal, meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
  - 1. Primer thickness 0.5 to 2.0 mils. Top coat thickness 0.8 to 1.2 mils.
  - 2. Gloss according to ASTM D523, 80% ±5%. Gloss retention after 1 year shall exceed 50%.
  - 3. Crosshatch adhesion according to ASTM D3359, 4B-5B.
  - 4. Impact resistance according to ASTM D2794, 120-inch pounds to 160-inch pounds.
  - 5. Salt spray according to ASTM B117, 1000+ hours.
  - 6. Humidity according to ASTM D2247, 1000+ hours.
  - 7. Water soak according to ASTM D2247, 1000+ hours.
- B. Painting of hoses, clamps, wiring harnesses, and other nonmetallic service parts shall not be acceptable. Fasteners used shall be corrosion-resistant and designed to minimize marring of the painted surface when removed for normal installation of service work.
- C. The enclosure shall include hinged doors for access to both sides of the engine and alternator and the control equipment. Key locking and padlockable door latches shall be provided for all doors. All hardware and door hinges shall be stainless steel. All doors shall be provided with door stops to hold them in the open position.
- D. The enclosure shall include flexible coolant and lubricating oil drain lines that extend to the exterior of the enclosure, with internal drain valves and external radiator fill provision.
- E. The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure. Silencer exhaust shall include a raincap and rainshield.
- F. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in an ambient temperature of up to 100°F. The enclosure shall reduce the sound level of the generator set while operating at full-rated load to a maximum of 68 dBA at any location, 7 meters from the generator set in a free-field environment.

G. The enclosure shall be insulated with nonhygroscopic materials.

## 2.08 TOOLS AND SPARE PARTS

- A. The required spare parts for the generator shall be those as recommended by the manufacturer and shall include the following items as a minimum:
1. All special tools required for normal operation and maintenance.
  2. One air cleaner element.
  3. One oil filter.
  4. One set of fan belts.
- B. All spare parts shall be packed in containers that are clearly identifiable with indelible markings on containers.

## 2.09 SCHEDULED OIL SAMPLING

- A. In order to minimize engine downtime, the supplier of the standby generator must provide an oil-sampling analysis kit that operating personnel shall use for scheduled oil sampling.
- B. Scheduled oil sampling shall be of the atomic absorption spectrophotometry method and shall be accurate within a fraction of one part per million for the following elements: iron, chromium, copper, aluminum, silicon, and lead. In addition, the sample shall be tested for the presence of water, fuel dilution, and antifreeze.
- C. All equipment needed to take oil samples shall be provided in a kit at the time of acceptance and shall include the following:
1. Sample extraction gun (1).
  2. Bottles (10).
  3. Postage paid mailers (10).
  4. Written instructions (1).
- D. Immediate notification shall be provided to OWNER when analysis shows any critical reading. If readings are normal, a report showing that the equipment is operating within established parameters shall be provided.
- E. The scheduled oil-sampling kit shall be made available at additional cost to OWNER beyond the mandatory starter kit specified previously and shall be optional for OWNER to continue this service after the starter kit has been depleted.

## 2.10 GENERATOR EMERGENCY SHUTDOWN PUSHBUTTON CONTROL STATION

- A. Furnish a red mushroom head, maintained-type pushbutton control station for manual initiation of a generator emergency shutdown. When the emergency stop pushbutton is pressed, the generator shall shut down and remain shut down until the emergency stop pushbutton is manually reset and the generator is called to run.
- B. The control station shall be labeled "Generator Emergency Shutdown."
- C. The control station shall be provided with a NEMA 4X, stainless steel enclosure and two sets of N.O. and N.C. contacts to monitor signal at the generator.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. The standby power system shall be installed as shown on the drawings and in accordance with the manufacturer's recommendations and all applicable codes.
- B. Installation of equipment shall include providing all interconnecting wiring between all major equipment provided for the on-site power system. CONTRACTOR shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site. All connections (e.g., fuel, water, electrical) to generator shall be made with flexible material/fitting to accommodate unit vibration.
- D. Equipment shall be initially started and operated by representatives of the manufacturer.
- E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- F. Maximum generator height, exhaust piping, silencer, etc., shall be 3 feet 10 inches. CONTRACTOR shall be responsible for all required coordination.

### 3.02 FIELD START-UP AND COMMISSIONING

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist CONTRACTOR in installation and start-up of the equipment specified in this section. The manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general operation of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional testing of the system. Upon completion of the manufacturer's start-up and testing, the manufacturer shall generate a site start-up and test report, documenting all systems checked, as well as any incomplete work remaining and operational deficiencies.
- C. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal work day (not including start-up) at a job-site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly and major components within the assembly.
- D. CONTRACTOR shall provide three copies of the manufacturer's site start-up and test report to ENGINEER for review. Once ENGINEER has reviewed the report and all equipment is operating in accordance with the specifications, ENGINEER will make one site visit to check operation of the system. If the system is not ready or does not operate as specified, OWNER shall deduct payment to CONTRACTOR and make payment to ENGINEER for additional

travel, expenses, and site visits until the equipment operates as specified. CONTRACTOR shall be responsible for all fuel, and electrical costs required to check operation of the system.

### 3.03 TESTING

- A. In addition to the standard factory tests, there shall be a 4-hour continuous load bank test at the jobsite before connection to load transfer switch, with loads from 10% to 100% of rated capacity to check voltage, frequency, fuel, air cooling, and ventilating systems so that they can be determined adequate for the application. This test shall be accomplished with a portable three-phase resistive load bank. All emergency warning and detection equipment shall be demonstrated to be operable by simulating failures. A signed test report shall be submitted to OWNER and ENGINEER with deficiencies noted, if any. After this test, the generator shall be connected to the plant and the operation and maintenance of the unit comprehensively demonstrated to OWNER. Correct phasing between the engine-generator and station shall be verified so that it will handle load. A minimum of two power failures shall be simulated.
- B. In addition to the load bank test above, after the unit is connected to the system, three simulated outages and a 1-hour run period on the actual facility shall also be provided.
- C. CONTRACTOR shall be responsible for all fuel costs for these tests.

END OF SECTION

## SECTION 26 36 23

### AUTOMATIC TRANSFER SWITCHES

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Provide an automatic transfer switch control system where shown on the drawings.
  - 2. The system shall be a completely integrated assembly for automatic, unattended operation and control of the standby power system. System operation shall be as described in the following sections.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00-Submittals.
- B. Shop drawings shall include the following:
  - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
  - 2. Detailed layouts of all cubicles and equipment.
  - 3. The manufacturer shall furnish schematic and wiring diagrams for the automatic transfer switch and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

##### 1.03 QUALITY ASSURANCE

- A. The transfer switch shall be listed by Underwriters Laboratories, Inc. (Std. 1008) and be approved by the Canadian Standards Association.

##### 1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the date established for Substantial Completion of the project.

#### PART 2-PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. The automatic transfer switch shall be as manufactured by Cummins Power Generation OTPC, Kohler KSP, 125-amp, 4-pole, or equal.

- B. The drawings and specifications were prepared based on Cummins Power Generation. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

## 2.02 AUTOMATIC TRANSFER SWITCHES

- A. Provide complete automatic transfer switch as shown on the Drawings. Interlocked molded case circuit breakers or contactors are not acceptable.
- B. The transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a nonventilated enclosure constructed in accordance with Underwriters Laboratories, Inc., UL 1008. The transfer switch shall be provided with a NEMA 1 enclosure.

## 2.03 CONSTRUCTION AND PERFORMANCE

- A. The transfer switch shall be double-throw, actuated by a single electrical operator momentarily energized and connected to the transfer mechanism by a simple overcenter linkage, with a minimum transfer time of 400 milliseconds.
- B. The transfer switch shall have the ability to detect under and over-voltage, under and over-frequency, voltage imbalance, incorrect phase rotation, and phase loss.
- C. The time delay between the opening of the closed contacts and the closing of the open contacts shall allow for voltage decay before transfer.
- D. The transfer switch shall allow the motor and transformer loads to be reenergized after transfer with normal inrush current. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.
- E. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and standby positions without the use of hooks, latches, magnets, or springs and shall be silver tungsten alloy. All contacts shall be 100% rated. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches.
- F. The transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. The manual operator shall provide the same transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.
- G. The transfer switch shall be equipped with a digital display that has the ability to monitor load power conditions, network status, review transfer switch events, and adjust transfer switch parameters. The display shall also include a bar graph display that indicates the level of power being supplied to the load as well as three-phase voltage, current, frequency, power factor, and kilowatts.

## 2.04 SEQUENCE OF OPERATION

- A. Engine starting contacts shall be provided to start the generating plant should the voltage of the normal source drop below 80% on any phase after an adjustable time delay to allow for momentary dips. The transfer switch shall transfer to standby when 90% of rated voltage



and frequency has been reached. After restoration of normal power on all phases to 90% of rated voltage, an adjustable time delay period of zero to 31 minutes shall delay retransfer to allow stabilization of normal power. If the standby power source should fail during this time delay period, the switch shall automatically return to the normal source. After retransfer to normal, the engine-generator shall be allowed to operate at no-load for a period of 5 minutes. Two auxiliary contacts rated 25 amps, 120 volts shall be mounted on the main shaft; one closed on normal, the other closed on standby. All relays, timers, control wiring, and accessories shall be front accessible. In addition, one set of relay contacts shall be provided to open upon loss of the normal power supply. All control wire terminations are to be identified by tubular sleeve-type markers.

- B. The automatic transfer switch shall include the following functions. Adjustable time delays and features described below shall be operator-adjustable from the front of the transfer switch and shall not require the use of a laptop, software, or external programming device.
1. Time delay to override momentary normal source power outages to delay engine start signal and transfer switch operation. Adjustable 0.5 to 90 seconds.
  2. Time delay relays to control contact transition time on transfer to either source, adjustable 1 to 300 seconds (Programmed Transition).
  3. Time delay on retransfer to normal. Adjustable 0 to 31 minutes, with engine overrun to provide fixed 5-minute unloaded engine operation after retransfer to normal.
  4. Test with load-Auto-Test without load selector switch to simulate normal power failure. (Maintained Type).\*
  5. Contact to close on failure of normal source to initiate engine starting or other customer functions.
  6. Contact to open on failure of normal source to initiate engine starting or other customer functions.
  7. Green pilot light to indicate switch in normal position.\*
  8. Red pilot light to indicate switch in standby position.\*
  9. Auxiliary contacts rated for 5 amps at 120 volts AC for monitoring each of the following signals at the SCADA System:
    - a. Normal Source Available.
    - b. Normal Source Connected.
    - c. Emergency Source Available.
    - d. Emergency Source Connected.
    - e. Not-in-Auto.
    - f. Failed to Transfer.
  10. Adjustable relay to prevent transfer to standby until voltage and frequency of generating plant have reached acceptable limits.
  11. Plant exerciser with 7-day time clock, multiple test schedules, and programmable exceptions for holidays, weekends, etc.
  12. The transfer switch shall accept a maintained dry contact input to initiate a test with load when the contact closes. The test shall remain active until the dry contact input opens.

\* Front cabinet door mounted.

- C. When coordinated with circuit breakers, the automatic transfer switch shall have the following short-circuit withstand capability:

Withstand Capability (RMS Amps, Symmetrical) Testing at 480 Vac	
Switch Ampere Rating	ATS Coordinated with Molded Case Circuit Breakers
125	30,000

- D. During the withstand tests, there shall be no contact welding or damage. The tests shall be performed on identical samples without the use of current limiting fuses. Oscillograph traces across the main contact shall verify that contact separation has not occurred. These procedures shall be in accordance with UL 1008 and testing shall be certified by Underwriters Laboratories or any nationally recognized independent testing laboratory.
- E. When conducting temperature rise tests to UL 1008, the manufacturer shall include postendurance temperature rise tests to verify the ability of the transfer switch to carry full-rated current after completing the overload and endurance tests.
- F. As a precondition for approval, the manufacturer of the automatic transfer switch shall verify that his switches are listed by Underwriters Laboratories, Inc., UL 1008 with withstand and close-in values at least equal to the interrupting rating of the circuit breaker and/or fuse that is specified to protect the circuit.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. The installation of this system shall comply with the directions and recommendations of authorized factory representatives. These representatives shall offer the supervision necessary for proper installation.
- B. A final inspection and an initial start-up of the system shall be provided by the factory representatives.
- C. A letter of certification written by the authorized factory representatives which states that the system is properly installed and does properly function as recommended by the factory and as described herein shall be submitted to ENGINEER.
- D. A test run shall be performed by the authorized factory representatives in the presence of CONTRACTOR and ENGINEER or their representatives; the time of this test run shall be mutually agreed upon by all persons concerned.

### 3.02 START-UP AND TRAINING

- A. CONTRACTOR shall include 8 hours of start-up by a certified, factory-trained engineer. Start-up services shall include, but not be limited to, inspection of CONTRACTOR installation and functional testing of the ATS assembly. On-site time shall be over and above the cost of travel and travel time to the site.
- B. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal workday (not including start-up) at a job site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly, simulated outages, and review of major components within the assembly.

END OF SECTION

## SECTION 26 43 13

### SURGE PROTECTIVE DEVICES (SPD)

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: Service entrance devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/IEEE C62.41 and C62.45.
- B. NFPA 70 and 75.
- C. UL 1449, most recent issue.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of surge protective devices. Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide surge protective devices which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00-Submittals.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports certified by the manufacturer shall be provided to ENGINEER upon request for each model submitted.

## 1.05 WARRANTIES

- A. Manufacturer shall provide a minimum 20-year warranty from the date of substantial completion to cover repair or replacement of the device. This warranty shall include the field replaceable plug-in modules and coordinated fuses.

## PART 2-PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. The drawings and specifications were prepared based on ASCO. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, upsizing overcurrent protective devices to meet manufacturer recommendations. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

### 2.02 GENERAL

- A. These specifications describe the electrical and mechanical requirements for high energy transient voltage (service entrance and branch panels) surge suppressors. The specified surge protective device shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category C3. Testing shall be per ANSI/IEEE C62.45-2002 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes.
- B. The system individual units shall be UL listed under UL1449, latest edition, Standard for Surge Protective Devices (SPD). Surge ratings shall be permanently affixed to the SPD.
- C. Operating Temperature: Operating temperature range shall be -40 to +55°C (-40 to 131°F).
- D. Storage Temperature: Storage temperature range shall be -40 to +85°C.
- E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.
- F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
- G. Design Life: >15 years.
- H. Operating Voltage: Maximum continuous operating voltage shall be no less than 115% of the nominal rated line voltage.
- I. Power Frequency: SPD power frequency shall be rated for use on 50 and 60 Hertz power systems.
- J. All SPDs shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.
- K. SPD shall be suitable for use in Type 2 locations.

- L. Unit shall provide maximum ANSI/UL 1449 VPRs for 208Y/120-volt.
  - 1. L-N = 700 V.
  - 2. L-G = 700 V.
  - 3. N-G = 700 V.
  - 4. L-L = 1000 V.

## 2.03 SERVICE ENTRANCE DEVICES

- A. The maximum surge current capacity of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 250 kA per phase. The surge life (8/20) shall be at least 6 kA for 10,000 occurrences or 10 kA at 20 kV for 15,000 occurrences per mode. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating ( $I_n$ ) of 20 kA.
- B. The SPD shall have a minimum Short Circuit Rating (SCCR) of 200 KAIC. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
- C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.
- D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple fuse protected metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with multiple surge rated fuses per module or one fuse per MOV.
- E. Red and green solid-state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.
- F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.
- G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.
- H. A 14 gauge, NEMA Type 4, steel enclosure, with corrosion-resistant hardware shall be provided for the unit.
- I. Each SPD shall be provided with a remote capacitive touch liquid crystal display, capable of displaying power quality measurements and event logging. The remote display shall be ASCO Active Surge Monitor, or equal, with cable length as required.

- J. Service entrance devices shall be as manufactured by ASCO 560 Series, or equal.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.
- B. Each installed device shall be fed by an appropriately sized circuit breaker, per the manufacturer's installation notes, in the protected panel. No SPD shall be installed without an upstream overcurrent device.
- C. Units shall be installed as close as practical to the electrical panel. Low impedance cabling furnished by the manufacturer shall be utilized for installations with lead lengths greater than, or equal to, 5 feet. Low impedance cabling furnished by the manufacturer or appropriately-sized standard cable, if acceptable to ENGINEER may be utilized for installations with lead lengths less than 5 feet. SPD leads shall be as short as possible for best performance.
- D. Manufacturer shall provide protection modules and coordinated fuses under a no-cost lifetime replacement warranty.

END OF SECTION

## SECTION 31 10 00

### SITE CLEARING AND STRIPPING

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Removal of surface debris.
  - 2. Removal of paving.
  - 3. Strip and stockpile topsoil.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

##### 3.01 PREPARATION

- A. CONTRACTOR shall identify existing plant life to remain and shall tag accordingly.

##### 3.02 PROTECTION

- A. CONTRACTOR shall protect from damage utilities and structures that are to remain.
- B. See Division 01 for protection of survey monumentation.

##### 3.03 CLEARING AND GRUBBING

- A. Clearing and grubbing shall consist of cutting and disposing of trees, brush, windfalls, logs, and other vegetation, and the removing and disposing of roots, stumps, stubs, grubs, logs, and other timber from within the clearing limits as defined on the drawings, designated to be removed on the drawings or in the specifications, or fall within the excavation, embankment, or improved areas of the site.
- B. All roots and stumps shall be removed to a depth of not less than 12 inches below the original ground surface in embankment areas. In cut areas, such material shall be removed to a depth of not less than 12 inches below the subgrade.

##### 3.04 REMOVALS

- A. CONTRACTOR shall remove from the site all trees, brush, and other vegetation, debris, and rocks that fall within the excavation and grading limits, as well as any paving shown on the drawings to be removed.

### 3.05 STRIPPING

- A. Excavate topsoil from areas to be built upon, cut or filled, or to have surface improvements, including roadways and walks.
- B. Stockpile topsoil on-site and protect from erosion. CONTRACTOR shall provide additional topsoil as required.
- C. Excess topsoil, if any, shall be removed from the site and disposed of at CONTRACTOR's expense.

END OF SECTION



## SECTION 31 23 00

### EXCAVATION, FILL, BACKFILL, AND GRADING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
  - 1. Excavating for footings, foundations, roads, and utilities.
  - 2. Placing and compacting all fill and backfill.
  - 3. Placement of crushed stone fill below floor slabs and generator pad, or other structures where required.
  - 4. Rough and finish grading prior to paving, seeding, etc.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. There is estimated to be approximately 5 cubic yards of unsuitable foundation material for structures and roads as defined in this section.
- D. Payment:
  - 1. General excavation shall include all excavation specified, undercutting, fill, backfill and grading, including rock excavation but not including unsuitable foundation material, as hereinafter described.
  - 2. All general excavation shall be included in the Lump Sum Bid.

##### 1.02 REFERENCES

- A. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- B. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
- C. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the City of Madison Standard Specifications for Public Works Construction, latest edition, including all issued supplemental specifications.

##### 1.03 SUBMITTALS

- A. CONTRACTOR shall submit samples of materials proposed for use as fill to soils testing laboratory for analysis of their suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.
- B. CONTRACTOR shall submit sufficient samples of each different type or classification of soil to obtain representative values.

## 1.04 JOB CONDITIONS

- A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.
- B. Soil borings were made and the soils information is included in an appendix to these Specifications. The information contained is not guaranteed to be indicative of conditions to be encountered during construction. It is CONTRACTOR's responsibility to make its own investigations to determine physical conditions at the site, which may affect the work.

## PART 2-PRODUCTS

### 2.01 COMPACTED FILL

- A. All fill and backfill material designated to be compacted fill shall be granular with no stones larger than 4 inches and shall be reasonably well-graded throughout the particle size range. Of that portion of the material passing the No. 4 sieve, not more than 25% shall pass the No. 200 sieve, and material shall have less than 5% clay content. When placing fill during wet weather or in wet areas, this requirement shall be modified to not more than 5% passing the No. 200 sieve. Adequately dewatered areas are not defined as wet areas.
- B. Native material may be used as compacted fill. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

### 2.02 CRUSHED STONE FILL

- A. Crushed stone fill beneath new lower level floor slab, telemetry tower, and generator pad shall be 3/4-inch clear crushed stone and shall meet all requirements of ASTM C33 size No. 67.

### 2.03 EMBANKMENT FILL

- A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

### 2.04 CLAY FILL

- A. Clay fill shall contain at least 25% clay minerals (material finer than 0.002 mm).

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

### 3.02 PROTECTION

- A. CONTRACTOR shall provide all necessary sheeting, shoring, or other soil retention systems including all labor, material, equipment, and tools required, or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheeting, shoring, and other soil retainage systems shall be withdrawn or removed in a manner so as to prevent subsequent settlement of structures, utilities, and other improvements.
- B. Design of sheet piling and other soil retaining systems shall be the sole responsibility of CONTRACTOR. Where such systems are shown on the drawings, no parameters such as embedment depth, section profile, presence or lack of walers, etc., nor system type or suitability shall be inferred. CONTRACTOR is responsible for designing and providing a fully functional system compatible with construction and site requirements.
- C. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

### 3.03 UTILITIES

- A. Before starting excavations, CONTRACTOR shall locate existing underground utilities in all areas of the work.
- B. If utilities are to remain in place, CONTRACTOR shall provide adequate means of protection during earthwork operations.
- C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions.
- D. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation, and repair any damaged utilities to satisfaction of utility owner.
- E. CONTRACTOR shall not interrupt existing utilities serving facilities occupied and used by OWNER or others except when permitted in writing by OWNER.
- F. CONTRACTOR shall demolish and completely remove from the site existing underground utilities indicated to be removed after utility has been capped and sealed.
- G. CONTRACTOR shall accurately locate and record abandoned and active utility lines rerouted or extended on project record drawings.

### 3.04 FINISH ELEVATIONS AND LINES

- A. CONTRACTOR is responsible for setting and establishing finish elevations and lines.

### 3.05 EXCAVATION

- A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.
- B. All excavated material that does not meet the specification for compacted fill or embankment fill or meets the specification but is not required for backfill or fill shall be classified as excess material and shall be removed from the site and disposed of at CONTRACTOR's expense.
- C. All material other than suitable bearing soil or bedrock, as determined by the Project Soils Engineer, shall be removed from under concrete to be poured on ground.
- D. Excavation for all footings, foundation walls, elevated slabs, etc., shall be large enough to provide adequate clearance for the proper execution for the work within them.
- E. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 31 23 19-Dewatering.
- F. When excavations reach subgrade elevations as shown on the drawings or as specified herein, the Project Soils Engineer will observe the bottom material. Where, in the opinion of the Project Soils Engineer, unsuitable foundation material is found at the level of the subgrade, original material below the excavation necessary for construction according to grades shown or specified, shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.
- G. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation 1 foot plus a distance at least equal to 0.5 feet in each direction for each foot of undercut depth below footing grade.
- H. CONTRACTOR shall backfill and compact all overexcavated areas.
- I. Use a smooth-edged backhoe bucket for footing and foundation wall excavations in granular soils.
- J. Sand footing subgrade soils that are at least one foot above groundwater should be recompacted with a large vibratory plate compactor to densify soils loosened/disturbed during excavation.

### 3.06 PREPARATION OF SUBGRADE

- A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Project Soils Engineer.
- B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.

### 3.07 COMPACTED FILL AND BACKFILL

- A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.

- B. No fill shall be placed under water or over unsuitable subgrade conditions.
- C. All fill and backfill, except embankment fill and clay fill, shall be compacted as follows:
  - 1. Class 1 Compaction: This class of compaction shall apply to all fill areas under structures, piping, bituminous roadway and parking areas, and backfill within 10 feet of structure walls. All compacted material shall be placed in uniform layers not exceeding 8 inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557). Compaction shall be obtained by compaction equipment appropriate for the conditions.
  - 2. Class 2 Compaction: This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer of the fill shall be compacted to at least 90% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.
- D. No frozen material shall be placed nor shall any material be placed on frozen ground.
- E. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

### 3.08 EMBANKMENT FILL

- A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.
- B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment, and in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

### 3.09 GRADING

- A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the drawings.
- B. Grading Tolerances:
  - 1. Rough Grade: Buildings, parking areas, and sidewalks— $\pm 0.1$  feet.
  - 2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs— $\pm 0.03$  feet.
  - 3. Lawn areas away from buildings, parking areas, and sidewalks— $\pm 0.25$  feet.

### 3.10 PLACING CRUSHED STONE

- A. The same day that the subgrade is exposed, place 12 inches of crushed stone below footings and foundations. Compact in place.

### 3.11 COMPACTION TESTING

- A. Compaction tests shall be done by the Project Soils Engineer. Location and frequency of the tests shall be as recommended by the Project Soils Engineer and paid for by OWNER.

END OF SECTION

## SECTION 31 23 19

### DEWATERING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Removal of groundwater to allow belowgrade construction.
  - 2. Site grading to prevent surface water from entering the excavation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment:
  - 1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
  - 2. The cost for removal of groundwater and surface water shall be included in the lump sum bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.

##### 1.02 REFERENCES

- A. Wisconsin Administrative Code Chapter NR 141 and NR 811.
- B. See Division 01, Regulatory Requirements for permit requirements and water, erosion, and sediment control.
- C. City of Madison Standard Specifications for Public Works Construction, latest edition.

##### 1.03 SYSTEM REQUIREMENTS

- A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. No water shall flow over the work until the joints are complete or the concrete has set.
- B. Dewatering shall be sufficient to lower the piezometric level to at least 2 feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.
- C. In areas where rock is encountered, the water level shall be kept at or below top of rock, but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.
- D. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented.

- E. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

#### 1.04 QUALITY ASSURANCE

- A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.
- B. In particular, groundwater observation wells shall be provided and subsequently abandoned in accordance with NR 141. CONTRACTOR shall complete all observation well construction and abandonment forms as required by NR 141 and shall submit the forms to OWNER within 15 days of construction or abandonment activities.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

##### 3.01 DEWATERING

- A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.
- B. CONTRACTOR shall provide at least two groundwater observation wells near each area to be excavated to aid CONTRACTOR in determining whether the minimum specified requirements have been met prior to excavation. The observation well shall be a minimum 2-inch-diameter slotted PVC pipe. The observation well shall be installed and backfilled in such a way as to allow an accurate determination of actual groundwater levels. The observation well shall be properly abandoned after use unless specified otherwise.
- C. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages, and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.
- D. CONTRACTOR shall meet all requirements of applicable WDNR permits for construction pit or trench dewatering.
- E. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.



### 3.02 PROTECTION

- A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.
  
- B. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences to the greatest extent possible by using electric-driven pumps, or intake and exhaust silencers or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

## SECTION 31 25 00

### SLOPE PROTECTION AND EROSION CONTROL

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Erosion control devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. CONTRACTOR shall comply with all provisions of the City of Madison Specifications for Public Works Construction, latest edition.

##### 1.02 PAYMENT

- A. All costs associated with slope protection and erosion control shall be included in CONTRACTOR's Bid. This work shall include, but is not limited to, erecting fence, excavation, placing posts, backfilling, attaching woven wire and geotextile fabric; placing ditch checks; installing sediment traps; removing the fence at completion of project; cleaning and repairing; removing or spreading accumulated sediment to form a surface suitable for seeding; replacing silt fence and damages caused by overloading of sediment material or ponding of water adjacent to silt fence; and furnishing labor, tools, equipment, and incidentals necessary to complete the work in accordance with the Contract.

##### 1.03 REFERENCES

- A. Wisconsin Department of Natural Resources Conservation Practice Standards-Construction Site Erosion and Sediment Control (Conservation Practice Standards).
- B. Dane County Erosion Control and Stormwater Management Manual ([http://www.danewaters.com/pdf/manual/ecsm\\_manual.pdf](http://www.danewaters.com/pdf/manual/ecsm_manual.pdf)).
- C. City of Madison Standard Specifications for Public Works Construction, latest edition.

##### 1.04 REGULATORY REQUIREMENTS

- A. Land disturbance less than one acre. Where land disturbance activities do not exceed one acre, CONTRACTOR shall maintain site conditions where erosion and pollution are controlled.

- B. CONTRACTOR and its subcontractors shall execute and sign the following certification:

"I certify under penalty of law that I understand the terms and conditions of the General Pollutant Discharge Elimination System Permit that authorizes the storm water discharges associated with industrial activities from the construction site and as may be detailed in the Contract Documents. I agree to indemnify and hold OWNER harmless from any claims, demands, suits, causes of action, settlements, fines, or judgments and the costs of litigation, including, but not limited to,

reasonable attorneys fees and costs of investigation and arising from a condition, obligation or requirement assumed or to be performed by CONTRACTOR for storm water pollution and erosion control.”

- C. CONTRACTOR shall pay any fines or other fees resulting from failure of CONTRACTOR to comply with the permit requirements.

#### 1.05 QUALITY CONTROL

- A. Construct and maintain erosion sediment control measures in accordance with the Conservation Practice Standards.
- B. Check facilities weekly and after any rainfall event, and make needed repairs within 24 hours.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 32 11 23

### AGGREGATE BASE COURSE

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Aggregate base course for roads and parking areas.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Repair or replacement of aggregate base course shall be considered incidental and included in the price bid.
- D. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall repair all roads, shoulders, and gravel areas damaged in accordance with this section. All paved areas shall also be repaired in accordance with Section 32 11 26–Hot Mix Asphalt Paving.
- E. CONTRACTOR shall comply with all provisions of the City of Madison Specifications for Public Works Construction, latest edition. Where conflicts occur, City of Madison Standard Specifications control.

##### 1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the City of Madison Specifications for Public Works Construction, latest edition.

##### 1.03 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, and parking lots.

##### 1.04 SUBMITTALS

- A. Submit sieve analysis for proposed materials in accordance with Section 01 33 00–Submittals.

#### PART 2–PRODUCTS

##### 2.01 AGGREGATES

- A. Aggregate for base course shall meet the requirements of Part 3 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation.
- B. Base course shall be uniformly graded and shall conform to the requirements of Base Aggregate Dense, 1 1/4 inch.

- C. Material for top layer of shoulders shall meet the requirements of Base Aggregate Dense, 3/4 inch.

## PART 3-EXECUTION

### 3.01 PREPARATION

- A. The subgrade shall be graded and rolled to provide uniform density and shall comply with the profile and cross sections contained in the drawings. All street subgrade in cut areas and all areas to receive fill shall be proof-rolled in the presence of OWNER or ENGINEER with a heavily loaded triaxle dump truck or similar equipment prior to the placement of any fill materials or base course. The subgrade shall be prepared in accordance with Section 211 of the Standard Specifications.

### 3.02 CONSTRUCTION

- A. Base course grade shall be set to allow placement of thickness of asphaltic pavement shown or specified.
- B. Depth of base course shall be the existing depth or 9 inches, whichever is greater.
- C. Each layer of base course shall be wetted and rolled to provide maximum compaction in accordance with Section 305 of the Standard Specifications.
- D. The finished base course shall be fine graded in preparation for paving.
- E. After final grading, CONTRACTOR shall maintain the base course until asphaltic paving work has been completed.

END OF SECTION

## SECTION 32 31 23

### EXTRUDED POLYVINYLCHLORIDE (PVC) FENCING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Section includes PVC fencing and accessories.

##### 1.02 SUBMITTALS

- A. Shop Drawings: Layout of fence and gates with dimensions, details and finishes of component accessories and post foundations.
- B. Product Data: Manufacturer's catalog cuts indicating material compliance and specified options.
- C. Samples: Color selections for PVC. If requested, samples of materials.

##### 1.03 SPECIAL WARRANTY

- A. Provide manufacturer's Lifetime Limited Warranty.

#### PART 2—PRODUCTS

##### 2.01 MANUFACTURER

- A. Acceptable manufacturers include the following: Merchant Metals, Certainteed, or equal. Fence and accessories of Merchant Metals, listed in the following specifications, are set up as the standard of quality. Certaineed, if selected, has equivalent products that shall be used.
- B. PVC fences and gates must be obtained from a single source.
- C. PVC Fence:
  - 1. Style: Everguard® Estate Privacy (Estate Combo).
  - 2. Height: 6 feet 0 inches.

##### 2.02 PVC FENCE

- A. Pickets, rails, and posts, per ASTM F 964, fabricated from PVC extrusion. The PVC extrusions shall comply with ASTM D 1784, Class 13343, and have the following characteristics:
  - 1. Specific Gravity (+/- 0.02): 1.4.
  - 2. Izod impact ft. lbs./in. notch: (at 32°F) 2.41 and (at 73°F) 3.24.
  - 3. Tensile yield strength, psi: 6,720.
  - 4. Flexural yield strength, psi: 9,756.
  - 5. Elasticity modulus, psi: 381,000.
  - 6. DTUL psi: 155°F.
  - 7. Flame spread: 15.

- B. Specifications:
  - 1. Pickets: 7/8-inch by 6-inch.
  - 2. Rails: 1 1/2-inch by 5 1/2-inch.
  - 3. Posts: 5-inch square.
  - 4. Color: Tan.
  - 5. Post Cap: New England.

### 2.03 SETTING MATERIAL

- A. Concrete: Minimum 28-day compressive strength of 3,000 psi (20 MPa).

## PART 3-EXECUTION

### 3.01 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations.
- B. Clearly establish property lines and legal boundaries of work.

### 3.02 INSTALLATION

- A. Follow manufacturer's installation instructions for the appropriate style in setting posts. Set gate posts for gate opening specified in the construction drawings. Posts placed 24 inches to 36 inches in the ground, depending upon the style of fence and local conditions and set in concrete.
- B. Gate posts and corner posts on all fences and line posts on taller fences shall be filled with concrete for additional strength.
- C. Place assembled fence sections into position and slide rails into posts. The rails are secured into posts by tabs which are notched into the rails and catch on the inside wall of the post.
- D. Check each post for vertical and top alignment, and maintain in position during placement and finishing operation.

### 3.03 GATE INSTALLATION

- A. Install gates plumb, level and secure using bolt-on hardware supplied by the manufacturer.
- B. Adjust hardware for smooth operation.

### 3.04 ACCESSORIES

- A. Install post caps and other accessories to complete fence.

### 3.05 CLEANING

- A. Cleanup debris and unused material and remove from site.

END OF SECTION

## SECTION 32 92 00

### RESTORATION

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Placement of topsoil.
  - 2. Fertilizing.
  - 3. Seeding.
  - 4. Mulching.
  - 5. Maintenance.
- B. All areas disturbed by construction shall be restored. Borrow sites and disposal sites will not require seeding, but they shall be graded smooth.
- C. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- D. Payment: Payment for restoration shall be at the lump sum price bid. Costs for topsoiling, seeding, fertilizer, mulching, and maintenance of restored areas shall be included in the lump sum price bid. One percent of the total Contract price shall be retained following project completion until a uniform 2-inch growth of vegetation is established over all restored areas.

##### 1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the City of Madison Standard Specifications for Public Works Construction, latest edition.

##### 1.03 QUALITY ASSURANCE

- A. All work shall be in accordance with Standard Specifications, unless noted otherwise.

#### PART 2-PRODUCTS

##### 2.01 TOPSOIL

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, stones greater than 3/4 inches in size, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.
- B. Topsoil from the site may be used if it meets the above requirements.

##### 2.02 SEED

- A. Seed mix shall be Terrace (Sun and Shade) applied at a rate of 3.5 lbs. per 1,000 square feet as noted in section 207.2(a).



## 2.03 FERTILIZER

- A. Fertilizer shall meet the requirements listed in Section 201.2(b) and contain Nitrogen, Phosphoric Acid, and Potash not less than 10%.

## PART 3–EXECUTION

### 3.01 TOPSOIL

- A. Placing topsoil shall be in accordance with 202.3(a) of the City of Madison Standard Specifications. Topsoil shall be placed to a uniform depth of 6 inches in place. Topsoil placement shall be incidental to sodding or seed, fertilizer, and mulching.

### 3.02 SEEDING

- A. Seeding shall be performed in accordance with 207.3(a) of the City of Madison Standard Specifications and applied at a rate of 3.5 lbs. per 1,000 s.f.

### 3.03 FERTILIZER

- A. Fertilizer shall be applied at a rate of 17 lbs. per 1,000 s.f. per Section 207.3(c) of the City of Madison Standard Specifications.

### 3.04 MULCHING

- A. All areas receiving seed shall be mulched.
- B. Mulching shall be performed in accordance with Section 207.3(d) of the City of Madison Standard Specifications.

### 3.05 MAINTENANCE

- A. Seeding/sodding shall proceed concurrently with construction. Seeding/sodding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.
- B. Mow sod at regular intervals to maintain at a maximum height of 2 1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- C. Immediately remove clippings after mowing.
- D. Water to prevent seed/sod and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas which fail to show adequate catch. Bare spots shall not exceed 5 square feet in area and not exceed 3% of the total seeded areas.

- H. Immediately replace sod in areas which show bare spots or deterioration.
- I. Protect seeded areas with warning signs during maintenance period.
- J. Correct damage resulting from erosion, gullies, rills, or other causes by filling with topsoil, tamping, refertilizing, and reseeding or resodding if damage occurs prior to acceptance of work.

END OF SECTION

SECTION 33 32 00

SUBMERSIBLE PUMPING STATION

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1.1 SCOPE

General: This division includes Specifications for providing a submersible pumping station. The station shall consist of two submersible motor driven wastewater pumps, piping, valves, electrical controls and other necessary appurtenances as shown on the Drawings or called for in the Specifications.

Materials of construction for the pumps and related equipment shall be suitable for the environment in which they are to be located.

All hardware located in the wet well shall be stainless steel.

In addition to these specifications, the City of Madison Standard Specifications also apply. Where conflicts exist between the two specifications, the more restrictive provision applies.

The following Divisions and Sections apply to the installation of the pumping station:

Concrete Work (Not street construction related)	Division 03
Painting	Division 09
Electrical	Division 26
Piping and Appurtenances	Division 40

Pumping station shall be in conformance with requirements of the Wisconsin Department of Natural Resources and all applicable industry codes and laws.

2.1 GENERAL

Testing Pipelines: CONTRACTOR shall include the cost of all testing, cleaning and disinfection in the price Bid.

All Work shall be inspected, tested, and approved as required by federal, state and local rules and regulations and as specified in this section. Unless otherwise approved in writing before testing begins, all tests shall be witnessed by ENGINEER, and others as necessary. Test results shall be recorded and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.

All piping shall be tested in accordance with Division 40 23 10. All underground piping shall be backfilled or properly secured to avoid damage during testing. Should underground piping fail test, CONTRACTOR shall be responsible for removal and replacement of backfill as required. All piping, interior or exposed, shall be subject to test before being covered with insulation, or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.

All piping shall be flushed or blown out after installation prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents as required for testing.

General Arrangement Drawings: General arrangement drawings, including support system, of 3-inch or larger interior and 3-inch or larger exterior (above- and belowground) ductile iron piping shall be submitted to ENGINEER for approval. Additional shop drawing requirements are found in Division 1—General Requirements. Shop drawings for all interior and aboveground exterior piping shall be two-line drawings, drawn to scale.

### 3.1 ACCESS DOORS AND CASTINGS

See Section 08 31 13—Access Doors and Frames for aluminum access doors and frames.

### 3.2 SIGNS

Danger Sign: CONTRACTOR shall provide danger sign at the entrance to the wet well. Sign shall be fiberglass with black and red and white background, Brady Systems B-120, or equal. Sign shall be mounted on wet well top slab with expansion anchors and shall have the following wording:

DANGER  
PERMIT-REQUIRED  
CONFINED SPACE  
DO NOT ENTER

### 4.1 PIPE AND PIPE FITTINGS

Size and Type: All materials shall conform to the size and type shown on the Drawings or called for in the Specifications.

In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event fittings are not available, the type of joint shall be reviewed by ENGINEER.

Iron Pipe and Fittings: Ductile iron pipe and ductile or grey cast iron fittings conforming to Division 40 05 00 shall be provided for the pumping station and valve vault. Transition to force main material, if force main is of different material, shall be made downstream of the pumping station using appropriate transition fitting.

Compressed Air/Bubbler Piping System: Air piping between air compressor and bubbler panel shall be Schedule 40 stainless steel, ASTM A312, with threaded joints. All fittings, couplings, joints, and unions shall be rated for 150 psig and shall conform to ASTM A182 and ANSI B16.3.

Ball valves shall be stainless steel, two-piece body, 2000 pounds WOG, with stainless steel trim, threaded ends, and virgin TFE seat, Nibco Series 580, or equal.

All compressed air tubing between bubbler panel and piping in wet well, shall be stainless steel tubing conforming to ASTM A269. Fittings, elbows, unions, etc., shall be stainless steel four-piece ferrule type, as manufactured by Swagelok, or equal.

5.1 VALVES

Shutoff Valves: Unless otherwise indicated on the Drawings, shutoff valves shall be plug valves as specified in Division 40 05 00.

Check Valves: Unless otherwise indicated on the Drawings check valves shall be swing check valves with outside lever and weight as specified in Division 40 05 00.

6.1 INSTALLATION OF PIPE AND APPURTENANCES

Interior or Exposed Piping: Provide pipe supports for all piping. All interior or exposed pipelines shall be securely supported by adjustable saddles, brackets, or adjustable hangers supported directly by concrete, masonry Work or tile. Strap hangers, tin clips or U-hooks will not be acceptable. Piping shall be supported, even though not shown on the Drawings, using base fittings and concrete pads to 6 inches above the floor, Grinnell 264, B-line, or equal, adjustable pipe saddle stand with floor flange to 6 feet above the floor, and supporting clamps or inserts more than 6 feet above the floor. In general, the maximum spacing of supports shall not exceed 10 feet on centers. Except as specified for plumbing system, all PVC piping shall be supported using galvanized supports for flexible piping. Maximum spacing shall not exceed 5 feet on centers. Piping shall be adequately supported and braced to resist thrust at bends and joints. Plumbing system shall be installed with hangers and supports in accordance with the Plumbing Code. CONTRACTOR shall furnish and place hangers, supports, wall pipes and sleeves in the forms before concrete is poured wherever needed or shown on the Drawings.

All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete or rod ties. The weight of the piping shall be supported independently of connected equipment.

7.1 PUMPS

General: The pumps shall be Flygt Corporation, Fairbanks Nijhuis or equal meeting the following requirements using constant speed operation.

Pumps supplied under this Contract shall be capable of meeting the intermediate operating condition with change of impeller only. In the future, new pumps, motors, base elbow, and controls will be required to meet the ultimate condition. However, access door opening, pump separation, and guide bars shall be constructed to allow installation of a pump to meet the ultimate condition.

The Drawings and Specifications were prepared based on Flygt Corporation. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment, including, but not limited to, structural, mechanical, and electrical Work. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

OPERATING CONDITIONS

Pumping Conditions	Head Conditions at Given Flow								
	Normal Head			Minimum Head			Maximum Head		
	GPM	STATIC HEAD (ft)	TDH (ft)	GPM	STATIC HEAD (ft)	TDH (ft)	GPM	STATIC HEAD (ft)	TDH (ft)
Design	375	10.5	17.5	450	4.0	14.0	300	16.5	21.0

				Normal Operation Initial Design Minimum Efficiency	
HP	Voltage	Phase	RPM (Nominal)	Pump	Motor
3 (minimum)	208	3	1,800	62%	78.9%

Pump Series	Model
Xylem	NP 3085
Fairbanks Nijhuis	4" 5432 MVK

- a. Operate at the normal condition within +10% of given capacity at given head, or within +5% of given head at given capacity.
- b. While operating under suction head at the normal operating conditions, the pump design shall be such that the pump will operate satisfactorily without cavitation, excessive noise, or vibration when installed as shown on the Drawings and operating at the head specified.
- c. Motor horsepower shown is the minimum requirement. The motor shall be large enough not to be overloaded at any point on the design curve for the pump chosen to meet the operating conditions.
- d. The maximum and minimum head conditions are given as a guide to the shape of the head discharge curve. The pumps shall have a head discharge curve of the same shape or steeper within the guidelines previously specified.
- e. Be designed to operate in submerged condition in the space allotted.
- f. Be vertical, nonclog centrifugal wastewater pumps with integral motors designed and assembled by same manufacturer.
- g. Be capable of handling solids and long stringy materials, found in raw unscreened wastewater.
- h. With its appurtenances and cable, be capable of operation with continuous submergence without loss of watertight integrity to a depth of at least 65 feet.
- i. Be capable of running continuously at full nameplate rated load while the pump is submerged, partially submerged or;
- j. The use of shower systems, secondary pumps, or cooling systems to cool the motor shall not be acceptable.
- k. Be UL, CSA, or FM approved for Class I, Division 1, Group C and D hazardous locations.

Pump Retrieval System: The design of the pumps shall be such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, permanently installed in the wet well. The pump shall be easily removable for inspection or service, requiring no bolts, nuts or other fasteners to be disconnected, or need for personnel to enter the wet well.

A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the discharge connection, which when bolted to the floor of the wet well and discharge line, will receive the wet well discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices.

Alignment of the pump to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by no less than two stainless steel guide bars. Guide bars shall be of a diameter and wall thickness as recommended by the pump manufacturer. Provide stainless steel top guide bars brackets and intermediate guide bars brackets as required. Guide bars shall extend from access door to the discharge connection. No other motion of the pump unit, such as tilting or rotating, shall be required. Sealing of the pump to the discharge flange connection shall be by a machined metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, O-ring or other devices will not be considered acceptable, nor equal. No portion of the pump unit shall bear directly on the floor of the wet well. The entire weight of the pump shall be borne by the pump discharge elbow. There shall be no more than one 90 degree bend allowed between the volute discharge flange and station piping. Discharge connection to discharge pipe shall be an ANSI B16.1 Class 125 flange.

Pumps shall be fitted with a stainless steel cable of adequate strength to permit raising and lowering of the pumps for inspection or removal. Hoist end of pump retrieval cable shall be fitted with a swaged ball to allow of a swaged ball to allow for connection to pump lifting equipment. All components shall be of adequate size, length, and strength for the pump being lifted and shall be provided so as to allow cable to be connected to and automatically be wound on a winch.

Pump Construction: All major parts, such as the stator casing, lubricant casing, sliding bracket, discharge connection, volute and impeller shall be of cast iron with smooth surfaces. All exposed bolts, screws and nuts shall be stainless steel construction. All metal surfaces coming in contact with the pumped liquid other than steel or brass shall be protected by a manufacturer selected paint system.

All mating surfaces of major parts shall be machined and fitted with O-rings where watertight sealing is required. Machining and fitting shall be such that sealing is accomplished by automatic compression in two planes and O-ring contact made on four surfaces, without the requirement of specific torque limits to affect this. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered adequate, or equal. Tolerances of all parts shall be such that allows replacement of any part without additional machining required to provide sealing as described above. No secondary sealing compounds, greases or other devices shall be used.

Pump Volute: Pump volute shall be of single piece grey cast iron of non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide the trash release pathways and the sharp edge(s) across which each impeller vane leading edge shall cross during rotation so as to remain unobstructed. The insert ring shall be of hardened cast iron construction and shall provide effective sealing between the multivane semiopen impeller and the volute housing.

Pump Motor: The pump motor shall be housed in an air-filled watertight chamber and shall have moisture-resistant Class H insulation. The pump motor shall be NEMA Design B designed for continuous duty. Motor shall be capable of sustaining at least 15 evenly spaced starts per hour.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of  $\pm 10\%$ . The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. Motor shall meet the requirements of NEMA MG-1 part 31 and be suitable for VFD operation.

A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output KW and efficiency. This chart shall also include data on starting and no-load characteristics.

Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

#### Pump Protection:

The motor stator shall incorporate three thermal switches in series to monitor the temperature of each phase winding. At a temperature preset to protect the motor the thermal switches shall stop the motor and be capable of activating an alarm. These thermal switches shall be used in conjunction with and be supplemental to motor overload protection.

A float-type leakage sensor (FLS) shall be provided to detect fluid in the stator. When activated, the sensor shall be capable of stopping the motor and activating an alarm. The thermal switches and sensor shall be connected to a 120-volt mini CAS module which shall be mounted in the pump starter enclosure by Division 26.

A Mini-CAS unit rated for 120 VAC power supply shall be provided for installation in the MCC bucket.

Provide a stainless steel kellum grip for each cable.

Pump Shaft: Pump and motor shaft shall be one unit. Couplings are not acceptable. The shaft shall be made of stainless steel. The shaft shall rotate on two permanently lubricated bearings with a minimum L-10 bearing life of 50,000 hours when pump is operating at any usable point of the pump curve. Bearings shall compensate for axial thrust and radial forces.

Mechanical Seals: Each pump shall be provided with a tandem mechanical shaft seal system consisting of two independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces. The lower primary seal unit between the pump and lubricant chamber shall contain one stationary and one positively driven rotating tungsten carbide ring. The upper secondary seal unit between the lubricant chamber and the motor housing shall contain one stationary and one positively driven rotating tungsten carbide seal ring. Each interface shall be held in contact by its own spring system and not require being supplemented by external liquid pressures. Both seals shall be mounted on the shaft. The lower seal shall not be mounted on the impeller hub. The seals shall require neither maintenance nor adjustment, nor depend on direction of rotation for sealing. Shaft seals without positively driven rotating members or conventional double mechanical seals with a common single or double spring acting between the upper and lower units, requiring a pressure differential to offset external pressure and effect sealing shall not be considered acceptable, nor equal to the dual independent seal system specified.

The pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive antileak seal shall be easily accessible from the outside. No seal damage shall result from operating the pump in an unsubmerged condition. The seal system shall not rely on the pumped media for lubrication.



The impeller shall be of hardened cast iron dynamically balanced, semi-open, multivane, backswept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and treated with a corrosion inhibitor.

Pump Motor Cable: The pump motor cable shall be suitable for submersible pump applications. This shall be indicated by a code or legend permanently printed on the cable. Cable size shall conform to NEC and ICEA Standards and shall be of adequate size to allow motor voltage conversion without replacing the cable. Provide a stainless steel Kellum grip strain relief on motor cable to support cable at the cover. Provide minimum 50 feet of cable for each pump, more as necessary. Cable shall be of sufficient length to provide continuous run from in-place pump to point of cable connection. All ends of pump cables shall be fitted with a rubber shrink-fit boot to protect cable prior to installation.

Cable Entry Seal: A cable entry seal shall be provided where the pump cable enters the pump. The cable entry seal design shall preclude specific torque requirements to provide a watertight and submersible seal. The cable entry shall consist of cylindrical elastomeric grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by stator lead sealing gland or a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be required or used.

Pump Cooling System: The pump shall be provided with an integral motor cooling system. The system shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. Impeller back vanes or an impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling media channels and ports shall be nonclogging. Provisions for external flushing shall be provided. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers, or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

Pump Controls: All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 26 and Section 26 09 00.

Anchor Bolts: CONTRACTOR shall provide anchor bolts necessary for equipment furnished. Anchor bolts shall be stainless steel and be of ample strength for the intended service.

Pump Finishes: It is the intent of these Specifications that the submersible pumps be furnished shop primed and factory finished painted. Priming and finish painting shall be as recommended by manufacturer and shall be suitable for the uses described in these Specifications. Touch-up paint shall be provided by manufacturer.

### Pump Testing:

Factory Test: Each pumping unit to be furnished shall be fully performance tested with water in the manufacturer's facility in accordance with the Standards of the Hydraulic Institute to determine compliance with the rated conditions. Certified test curves, test data, and computations shall be submitted for approval prior to shipment and shall include the following:

1. Pump performance curves to meet the specified operating conditions defined under Section 7.1 General. Each pump performance curve shall show:
  - a. Head versus Discharge.
  - b. Pump Efficiency.
  - c. Break Horsepower.
  - d. NPSHr for maximum flow conditions.
  - e. Hydrostatic pressure test for casing at 75 psi.
2. Installed Test: Prior to startup at OWNER's facility, manufacturer's representative shall certify that equipment has been properly aligned and installed. During equipment startup, manufacturer's representative shall confirm each pump is operating properly as specified. Report shall be submitted verifying test. Pump shall be modified if specified conditions are not met.
3. Start-Up Tests: The pump manufacturer shall perform the following inspections and tests on each pump at start-up:
  - a. Impeller, motor rating, and electrical connections shall first be checked for compliance to the specifications.
  - b. A motor and cable insulation test for moisture content or insulation defects.
  - c. Verify correct rotation.
  - d. Verify proper voltage.
  - e. Verify proper current draw on each phase.
  - f. Verify thermal sensor trip will shut down motor in Hand and Auto mode.
  - g. A written certified test report giving the above information shall be supplied after start-up.

Pump Warranty: The pump manufacturer shall warrant the units being supplied to OWNER against defects in workmanship and materials for a period of 5 years or 10,000 hours under normal use, operation and service. The warranty shall be in printed form and apply to all similar units.

Minimum pump requirements for submersible pumps shall be as follows:

### 8.1 PAYMENT

Cost for construction of the pumping station and valve manhole, connecting appurtenances and piping, electrical controls, and appurtenances, site work and paving, and site fencing as specified or as shown on the Drawings shall be paid for according to the lump sum prices bid for the Work.

END OF SECTION

## SECTION 33 52 16

### FUEL GAS DISTRIBUTION UTILITIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. This section contains specifications for all fuel utility distribution systems for this project. Work included:
1. Natural gas service.
  2. Natural gas—aboveground.
  3. Buried natural gas piping.
  4. Vents and relief valves.
  5. Unions and flanges.

##### 1.02 CODES AND STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
1. Wisconsin Administrative Code SPS 365—Fuel Gas Appliances and applicable standard(s).
  2. NFPA 54—National Fuel Gas Code (Current Edition).
  3. Polyethylene gas distribution piping shall be installed in accordance with CFR 49, Part 192, Subpart G (mains), Subpart H (service lines), applicable codes and regulations, and ASTM D2774.

##### 1.03 NATURAL GAS SERVICE

- A. All charges for the gas service as shown on the drawings, including the connection from the main in the street or other location to the gas meter, shall be paid by this Contractor, including setting of gas meter(s) and all work performed by the gas company.
- B. The Utility Company is Madison Gas and Electric. The natural gas utility provider contact information obtained during design is (608) 252-7373. CONTRACTOR is responsible to verify this information as well as installing and coordinating all aspects of the natural gas service.
- C. The secondary service pressure after the utility provided meter will be 2.0 psig, 300,000 BTU minimum, for the site, space, generator (standby power) and process heating.
- D. The tertiary service pressure and demand supplied to individual buildings shall be as shown on the drawings.
- E. Coordinate the natural gas service with the Utility. No allowance will be provided for installation of the new service and costs shall be included in the Lump Sum Bid for the work provided by the Utility. All other costs for the natural gas service shall also be included in the Lump Sum Bid.

## PART 2-PRODUCTS

### 2.01 NATURAL GAS-ABOVEGROUND

- A. See Section 23 11 23-Facility Fuel Gas Piping for specifications.

### 2.02 BURIED NATURAL GAS PIPING

- A. Manufacturers: Performance Pipe, a division of Chevron Phillips Chemical Company LP, JM Eagle, or equal.
- B. Buried natural gas pipe tubing, fittings, and joints shall be PE 2708 (PE 2406) polyethylene, SDR-11 or less, ASTM D2513 and D3350 pipe and fittings. Provide butt-weld fittings conforming to ASTM D3261 or socket-type fittings conforming to ASTM D2683.
- C. Polyethylene pipe tubing, fitting, and joint materials shall be compatible and by same manufacturer. Fabricated fittings shall not be used. Match fittings to service rating of pipe.
- D. Provide an anodeless riser connection between buried plastic gas service piping and metallic riser in accordance with the local codes. Provide a metallic riser consisting of HDPE fused coating on steel pipe for connection to aboveground building distribution piping. Underground horizontal metallic portion of riser shall be at least 24 inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser. Provide Elster, George Fischer Central Plastics, or equal.
- E. Gas Transition Fittings: Provide manufactured steel transition fittings approved for joining steel and polyethylene pipe, conforming to AGA XR0603 requirements for transition fittings. Transition fittings shall be manufactured by Continental, Elster, George Fischer Central Plastics, or equal.
- F. Underground installation of piping shall conform with ASTM D2774.
- G. Provide tracer wire as specified.

### 2.03 VENTS AND RELIEF VALVES

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

### 2.04 UNIONS AND FLANGES

- A. See Section 23 11 23-Facility Fuel Gas Piping for aboveground system specifications.
- B. Do not use flanges for underground gas or oil systems. Use fittings that are solvent-welded or fusion-bonded joints only.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Gas piping shall be installed in accordance with state, local, and utility codes and the National Fuel Gas Code, NFPA No. 54. All natural gas piping shall be tested in accordance with all state, local, and utility codes pertaining to natural gas service or service requirements. CONTRACTOR shall arrange for natural gas service and shall coordinate service size and location and shall furnish and install all shutoff valves and pressure reduction as required.
- B. CONTRACTOR shall excavate and lay all pipe to the line and grade shown on the drawings. Grade stakes will be required for all lines.
- C. Where piping is laid in native soil, the width of trench below the top of the pipe shall not exceed the nominal diameter of the pipe plus 2 feet for all pipelines. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used. If the maximum trench width is exceeded for any reason other than as otherwise specified, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense, unless CONTRACTOR can demonstrate that the pipe to be used is compatible with the resulting load applied.
- D. Thermoplastic pressure piping may be bedded in compacted sand. CONTRACTOR shall perform all necessary excavation and shall provide all required materials to provide this bedding. Bedding material shall conform to the requirements of ASTM C33. The material shall be hard, tough, and durable and shall meet the following gradation requirements.

PERCENTAGE BY WEIGHT PASSING

	Bedding Sand
1 inch	---
3/4 inch	---
1/2 inch	---
3/8 inch	100
No. 4	95 to 100
No. 8	80 to 100
No. 30	25 to 60
No. 100	5 to 20
Passing No. 200	2 to 10

- E. No materials native to the trench shall be used as bedding material unless they meet the above specifications.
- F. When piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
- G. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.

- H. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be sand. Cover material for PVC pressure or other thermoplastic piping may be sand.
- I. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously. Cover material shall be placed over the top of the pipe to the height as shown on Drawing 01-975-43A for Class "B" (minimum 12 inches) or Class "C" (minimum 6 inches) Bedding. This backfill shall be placed by hand in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. If bedding material conforming to any of the above three crushed stone or crushed gravel gradations is used as cover material, it need not be tamped. The remaining 6 inches to make up the required 1 foot of select cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4 inch.
- J. All cover material shall be placed in maximum 6-inch layers and compacted by hand tamping. Compaction shall be equivalent to that described under "Compacted Fill and Backfill" as specified in Section 31 23 00-Excavation, Fill, Backfill and Grading.
- K. Except as otherwise specified, all backfill above 1 foot above the pipe shall be "Compacted Fill and Backfill" as specified in Section 31 23 00-Excavation, Fill, Backfill and Grading.
- L. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
- M. Install an electrically conductive 10 gauge copper wire with yellow insulation with buried natural gas piping. The tracer wire shall be installed at a distance of 4 inches to 6 inches adjacent to the pipe. The wire and all of its connections shall be insulated to prevent corrosion.
- N. Do not install natural gas piping in same trench with other utilities. Minimum horizontal clearance between gas pipe and parallel utility pipe shall be 2 feet. Natural gas pipe shall not be installed through catch basins, vaults, manholes or similar underground structures.
- O. Natural gas entrances into buildings shall be above grade.
- P. Protection Against Shear and Bending Loads: In accordance with ASTM D2774, natural gas connections shall be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle, or tapping tee on a main pipe, and where pipes enter or exit casings or walls. The area surrounding the connection shall be embedded in properly placed, compacted backfill, preferably in combination with a protective sleeve or other mechanical structural support to protect the polyethylene pipe against shear and bending loads.
- Q. Butt, socket, and saddle fusion joints in polyethylene natural gas piping shall be made using procedures that have been qualified and approved by the Operator in accordance with Title 49, CFR, and Part 192.283.

- R. In accordance with CFR. 49, part 192, Section 192.285, the Operator shall review that all persons making heat fusion joints have been qualified to make joints in accordance with the Operator's Approved Qualified Fusion Procedures. The Operator shall maintain records of qualified personnel, and shall certify that qualification training was received not more than 12 months before commencing construction. CONTRACTOR shall review that all persons making heat fusion joints are qualified in accordance with this section.
- S. Butt fusion of unlike wall thickness: Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple or by mechanical means or electrofusion.
- T. Polyethylene natural gas pipe and fittings may be joined together or to other materials by transition fittings, fully restrained mechanical couplings, or electrofusion. These devices shall be designed for joining polyethylene to another material and shall be approved by ENGINEER for use in natural gas distribution system.
- U. When mechanical OD compression couplings are used, polyethylene natural gas pipe shall be reinforced with a stiffener in the pipe bore. Stiffeners shall be properly sized for the diameter and wall thickness of polyethylene pipe being joined. For service pipe connections, the stiffener length shall match the pipe end penetration depth into the coupling.
- V. General Excavation:
1. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this contract unless otherwise noted. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
  2. Work shall conform to other sections of Division 31, except where modified by this section.
  3. Pipe shall be placed only on dry foundations. No extra payment will be made to CONTRACTOR for dewatering.
  4. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill, and rock excavation, the removal of pavement, filling, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling. All above work shall be included in the Lump Sum Bid, except rock excavation as defined in Section 31 23 16.26–Rock Removal. See Section 31 23 16.26–Rock Removal for payment for rock.
  5. CONTRACTOR shall excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown. The bottom of the excavation shall be leveled off, all loose and disturbed soil shall be removed, and it shall be hand-tamped prior to pipe, manhole, etc., installation. Where requested by ENGINEER, original material below the excavation necessary for construction according to grades shown or specified shall be removed and replaced.
  6. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on the drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.

7. Excavated native material that is unsuitable or not required for filling shall be removed from the site. Materials to be used for fill and suitable for this purpose shall be deposited where required except that no fill shall be placed where trenches for sewers, water lines, or other services will be located until after the trench work is completed.
  8. CONTRACTOR shall provide adequate shoring, sheet piling, and bracing to prevent earth from caving or washing into the excavation and shall do all shoring and underpinning necessary to properly support adjacent or adjoining structures. All shoring, sheet piling, and underpinning must be maintained until permanent support is provided.
  9. Any water, drainage, gas, sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance with the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.
- W. Gas lines shall not be installed under buildings, structures, or in crawl spaces.
- X. A Schedule 40 steel sleeve shall be installed on all natural gas risers passing through asphalt or concrete slabs. Allow at least 1 inch of radial clearance between sleeve and riser. Void shall be filled with pea gravel.
- Y. Natural gas piping shall be buried a minimum depth of 36 inches, unless noted otherwise.
- Z. Do not route piping through sub-grade utility vaults.
- AA. Install all valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.
- BB. Pitch horizontal piping down 1-inch in 60 feet in the direction of flow to dirt leg that is to be located in building for accessibility. When installing mains and branches, cap gas-tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- CC. Do not install gas pipe below a building or its foundation or in a ventilation air plenum.
- DD. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.
- EE. All joints in underground polyethylene gas pipe must be made by qualified personnel proficient in the joining methods of ASTM D2513 thermoplastic gas pressure pipe and polyethylene fittings. Do not install polyethylene gas pipe inside buildings.
- FF. Install shut off valves as shown on drawings. Provide valve box and valve operator per NFPA and AGA standards.
- GG. Blow compressed air into gas piping system as a part of commissioning system, before placing into service, to clean piping until target cloth is clean and free of debris.
- HH. Use for all underground metallic piping or underground metallic gas conduit.



- II. Remove all dirt and other foreign material from exterior of pipe. Apply primer as recommended by the manufacturer. Use a spiral wrap process for applying tape to the pipe. Repair any breaks in the tape coating caused by the installation process.
- JJ. Concealed or underground unions or flanges are not acceptable.
- KK. Not required as no flanges are permitted underground.

3.02 FIELD QUALITY CONTROL

- A. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.
- C. Conduct pressure test with test medium of air unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Division's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- D. Do not backfill pipe until it has been successfully tested.
- E. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.
- F. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

System	Pressure	Medium	Duration
Natural gas	100 psig	Air	24 hr

- G. On piping that cannot be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

END OF SECTION

## SECTION 40 05 00

### PIPING AND APPURTENANCES

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
1. All piping and valves of every description except as specified in Divisions 23 and 33.
  2. Concrete foundations and anchor bolts for all equipment furnished under this section.
  3. Piping connections to all equipment, whether furnished under this section or not.

##### 1.02 SUBMITTALS

- A. General arrangement drawings, including support system of 3 inches or larger interior and 3 inches or larger exterior (aboveground) ductile iron piping, shall be submitted to ENGINEER for approval. Shop drawings for all interior and aboveground exterior piping shall be two-line drawings drawn to scale. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, supports, and valves and appurtenances. Plug valve orientation, including operator and plug orientation, shall be shown on drawings.

#### PART 2-PRODUCTS

##### 2.01 MATERIALS OF CONSTRUCTION

- A. Materials of Construction: All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. Products used in potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372.
- B. Size and Type:
1. All materials shall conform to the size and type shown on the drawings or called for in the specifications.
  2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER. All grooved joint couplings and fittings shall be of the same manufacturer.

##### 2.02 PIPE AND PIPE FITTINGS

- A. Ductile Iron Piping and Ductile and Cast Iron Fittings:
1. Unless otherwise shown or specified, all piping 3 inches in diameter or larger shall be ductile iron conforming to ANSI/AWWA C151/A21.51, with flanged or grooved joints as

shown on the drawings. Unless otherwise shown or specified, all piping shall be minimum special thickness Class 53 with a minimum rated working pressure of 250 psi for flanged pipe. Pipe wall thickness shall be furnished as required by AWWA C115 for flanged piping; AWWA C606 for grooved piping; special thickness Class 53 minimum unless otherwise shown or specified. Manufacturers of flanged pipe and fittings shall be certified to NSF 61 by an ANSI-accredited third-party certification organization.

2. The words "Ductile Iron" and the weight and class of pipe shall be plainly marked on each piece of pipe.
3. All flanged sections of pipe shall be made up in strict accordance with AWWA C115 specifications. No field make-up flanges will be allowed unless strictly conforming to AWWA C115 with facing done after turning pipe through flange.
4. Flanged joints shall conform to AWWA C110, C111, and C115, and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron. Flanged gaskets shall be minimum 1/8-inch, full-face, rubber-ring, Toruseal, Flange-Tyte, Maloney, or equal, gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressure and installation conditions specified or shown.
5. Flanged bolts and nuts installed in wet wells and other submerged locations shall be 316 stainless steel.
6. Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
7. All ductile iron fittings shall be American, Clow, Griffin, Tyler, U.S. Pipe, or equal. No compact fittings are allowed.
8. Unless otherwise specified, all ductile iron piping and fittings shall be cement mortar lined and asphaltic-coated inside. Cement mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Exterior exposed, submerged, and interior piping shall be furnished with outside surfaces prepared by abrasive blasting in accordance with NAPF 500C-03. Cleaned surfaces shall then be shop-primed. Shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline or Tnemec 140-1255 Beige Pota-Poxprimer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all piping, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.
9. Unless otherwise specified, piping and fittings in manholes and wet wells shall be as furnished above for exterior exposed and interior piping.

**B. Copper Piping:**

1. Copper piping shall conform to the requirements of ASTM B88.
2. All interior or aboveground potable and non-potable water supply piping and sump pump discharge piping smaller than 3 inches shall be Type K hard copper. Fittings shall conform to ANSI B16.22 wrought copper and be soldered or sweated on. No lead-based solder may be used. Flux for potable water systems shall meet NSF 61. Piping shall run exposed in buildings, except in finished areas.
3. All underground water supply piping 2 inches and smaller shall be Type K soft copper with compression fittings. Joints shall not be used under floor slabs.
4. Shutoff valves shall be placed on each branch for all underground, aboveground, or interior piping.

5. Pump vent and drain lines, seal water supply and other small-diameter interior piping from the PW or NPW source, and manometer lines shall be rigid, Type K hard copper. An ample number of unions shall be provided for disassembling. Pump vents shall be valved.
- C. Compressed Air/Bubbler Piping System:
1. Air piping between air compressor and bubbler panel shall be Schedule 40 stainless steel, ASTM A312, with threaded joints. All fittings, couplings, joints, and unions shall be rated for 150 psig and shall conform to ASTM A182 and ANSI B16.3.
  2. Ball valves shall be stainless steel, two-piece body, 2000 pounds WOG, with stainless steel trim, threaded ends, and virgin TFE seat, Nibco Series 580, or equal.
  3. All compressed air tubing between bubbler panel and piping in wet well, shall be stainless steel tubing conforming to ASTM A269. Fittings, elbows, unions, etc., shall be stainless steel four-piece ferrule type, as manufactured by Swagelok, or equal.
- D. Galvanized Iron Piping: Unless otherwise shown or specified, all piping smaller than 3 inches shall be extra strong galvanized iron pipe, with Class 300 galvanized malleable iron fittings. An ample number of unions shall be provided for disassembling pipe. Pipe shall conform to the "Specifications for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses," ASTM A53.

## 2.03 VALVES

- A. Plug Valves:
1. Shutoff valves in cast or ductile iron lines containing wastewater shall be DeZURIK Series PEF 100% port Eccentric, Val-Matic Cam-Centric Series, or equal.
  2. Eccentric-type valves shall be nonlubricated rectangular-ported with resilient faced plugs and end connections as shown on the drawings. The plug profile shall be of a cylindrical eccentric shape so that the vertical face of the plug is straight and the horizontal face is eccentrically curved in relation to the plug shafts. Segmented ball valves with spherical plugs shall not be acceptable. Port areas shall be at least 100% (PEF) of full pipe area. Valve bodies shall be of ASTM A126, Class B cast iron. Resilient plug facings shall be chloroprene or Buna-N, suitable for use with wastewater.
  3. Valves shall be furnished with corrosion-resistant seats, replaceable oil-impregnated permanently lubricated 316 stainless steel sleeve-type bearings and grit shaft seals on both upper and lower bearing journals that comply with the latest edition of AWWA C507 and C504. Bodies of 3-inch and larger valves shall be furnished with a minimum 1/8-inch-thick machined smooth-welded overlay seat of not less than 90% nickel. Seat area shall be raised surface completely covered with weld so that the plug face contacts only nickel. Sprayed or screwed-in seats are not acceptable. Valve shaft seals for valves 4 inches and larger shall be of the type using a stuffing box and pull-down packing gland. Shaft seals shall be designed for replacement with the line pressurized at design pressure with the plug in both the open and closed position. For submerged service, or in valve manholes, valve vaults, or underground utility structures, valves shall have stainless steel bolts.
  4. The design of the valve and stuffing box assembly shall be such that the packing can be adjusted or completely replaced without disturbing any part of the valve or operator assembly except the packing gland follower. Stuffing boxes shall have a depth sufficient to accept at least four rings of Buna-N vee-type packing. Valve seating adjustment shall be accomplished without removing the valve from the pipe line and with pressure in the line. For lever-operated valves, the plug position retention friction device shall consist

of an adjustable phenolic cone that clamps on the plug shaft or a moly sheath. Metal-to-metal friction devices shall not be acceptable.

5. Valve working pressure ratings shall be 175 psi for valves through 12 inches and 150 psi for valves 14 inches through 24 inches. Valves shall provide drip-tight shutoff up to the full pressure rating.
6. Extension stems and other accessories shall be provided as shown on the drawings and as required to allow easy access for operation of valves within reach from walkways or other access points. Extend operators to at least 24 inches above walkways. Extension stems for quarter-turn plug valves shall be fabricated from 2-inch pipe, and extensions stems for gear-operated valves shall be fabricated from steel or stainless steel rod. Extension stems, stem guides, and related hardware and accessories for submerged valves shall be stainless steel. Stems shall be provided with 2-inch operating nut or other mechanism as shown on the drawings. Stem guides shall be provided as recommended by the manufacturer. Maximum unsupported length of stem shall be limited to an l/r ratio of 200.
7. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated as specified in Division 09. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valves once assembled. Cleaned surfaces shall then be shop-primed. Shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, one coat of Tnemec No. 141 Pota Pox 80 epoxy primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Except as noted below, valve interior shall be shop-primed and finish painted with epoxy painting system or fusion-bonded epoxy system as specified above. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

**B. Check Valves:**

1. Except where noted, check valves in ductile iron lines carrying liquid shall be GA Industries Figure 220-DS, Apco Model 250 LW by DeZURIK, (lever and weight), or equal, 150 psi, ductile iron or iron body, bronze or stainless trimmed, swing check. Two levers and springs, heavier springs and/or additional weights shall be used if necessary to stop slamming.
2. Asphaltic varnish and coal tar coating are not allowed on check valves. Exterior of cast iron or steel valve body shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, one coat of Tnemec No. 141 Pota Pox 80 epoxy primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by

CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

2.04 PIPING APPURTENANCES AND MISCELLANEOUS MATERIALS

- A. General: Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER.
- B. Restrained Flanged Coupling Adapters: Restrained flanged coupling adapters shall be furnished and installed as shown on the Drawings. Restrained flanged coupling adapters shall be of ductile iron construction, complete with EPDM sealing gasket, and gripping wedges and torque limiting actuating screws. Restrained flanged coupling adapters shall be Series 2100 MEGAFLANGE by EBAA Iron, or equal.
- C. Quick Hose Disconnect: Quick hose disconnect shall be 8-inch stainless steel, F-adapter type, as manufactured by PT Coupling Co., Inc., Part No. 60F, or equal, with dust cap. Quick hose disconnects for chemical service shall be F-adapter type with dust cap.
- D. Pipe Coupling: Pipe couplings identified on the drawings shall be Dresser Type 38, Smith Blair 411, or equal, steel coupling. CONTRACTOR shall provide tie ears and tension ties where necessary to restrain pipe.
- E. Tension Ties: All tension ties, rod ties, and control rods shall be provided to resist a minimum 150 psi 250 psi pressure in the pipe line. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary. Rods shall be provided with nuts and washers on both sides of tie ears. All nuts shall be carbon alloy steel conforming to ASTM A563, and washers shall be hardened steel conforming to ASTM F436. Rods shall be ASTM A36 steel at a minimum. Tie rods shall be equally spaced around pipe. The following table lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

Pipe Size (inches)	150 psi Pressure		250 psi Pressure	
	Minimum Number	Minimum Size (inches)	Minimum Number	Minimum Size (inches)
4-10	4	5/8	4	5/8
12	4	5/8	4	3/4
14	4	3/4	4	7/8
16	4	3/4	4	1
18	4	7/8	4	1 1/8
20	4	1	4	1 1/4
24	4	1 1/8	4	1 1/2
30	4	1 3/8	7	1 3/8
36	8	1 1/4	8	1 1/2
42	12	1 1/8	12	1 1/2
48	11	1 3/8	22	1 1/4
54	11	1 1/2	22	1 3/8

- F. Floor Boxes: Provide floor boxes in concrete floors or slabs and as shown on the drawings. Floor boxes shall be Neenah R-7506-B, Clow F-5690, or equal. CONTRACTOR shall verify that all floor boxes are large enough to accommodate all operating nuts and wrenches. Provide one "Tee" valve key operator for each valve manhole and one for each tank with tank or channel drain.
- G. Mechanical Seals: Mechanical seals shall be 316 stainless steel Link Seal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer.
- H. Pressure Gauges: Provide a pressure gauge on each new pump discharge piping (total of two) in the valve pit at suction and discharge of all centrifugal pumps. Pressure gauges shall be Ashcroft, or equal, and shall have scale in psi with a maximum range equal to twice the normal operating pressure indicated in the submersible pump equipment specifications. Gauges shall have 4-inch minimum diameter stainless steel case, shall be connected to a mineral-oil filled diaphragm housing to separate the gauge from liquid in discharge line, and shall have accuracy of  $\pm 1\%$ . Provide isolation valve and union at connection to pipe to allow the gauges to be removed while the line is under pressure. Gauges shall be mounted to permit pressure readings from above without entering the valve pit.
- I. Tapping Sleeve: Tapping sleeve body and neck shall be made of heavy 18-8 Type 304 stainless steel. Flange shall, studs, nuts and washers shall be 304 stainless steel. Gasket shall be 1/4-inch thick, gridded and have a molded outlet ring to provide effective sealing. It shall be SSF 61-G Nitrile. All welded stainless steel surfaces shall be fully passivated. Sleeve shall be Smith-Blair Style 663, or equal.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.

### 3.02 INSTALLATION

- A. Interior or Exposed Piping:
  - 1. Provide pipe supports for all piping. Pipe support spacing and type shall, at a minimum, conform to manufacturer's recommendations unless more restrictive requirements are specified or shown on the drawings. All interior or exposed pipelines shall be securely supported by adjustable saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile. Strap hangers, tin clips, or U-hooks will not be acceptable. Piping shall be supported, even though not shown on the drawings, using base fittings and concrete pads to 6 inches above the floor, Anvil 264, B-line, or equal, adjustable pipe saddle stand with floor flange to 6 feet above the floor, and supporting clamps or inserts more than 6 feet above the floor. In general, the maximum spacing of supports shall not exceed 10 feet on centers. Except as specified for plumbing system, all PVC piping shall be supported using galvanized supports for flexible piping except as indicated. Stainless steel supports and fasteners shall be used in submerged locations, tanks, wet wells, or as indicated. Piping shall be adequately supported and braced to resist thrust at bends, rubber expansion joints, and joints. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place

- hangers, supports, wall pipes, and sleeves in the forms before concrete is poured wherever needed or shown on the drawings.
2. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties. The weight of the piping shall be supported independently of connected equipment.
  3. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Where vertical movement up to 1/8 inch is anticipated, a precompressed variable spring support shall be used. Rigid hangers shall be provided with a means of vertical adjustment after erection. Where horizontal piping movements are greater than 1/2 inch, or where the hanger rod angularity from vertical is greater than 4 degrees from hot to cold position of the pipe, the hanger pipe and structural attachments shall be offset in a manner that the rod is vertical in the hot position. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so stress will not be transferred to them.
  4. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
  5. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop-primed. Shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, Tnemec 140-1255 Beige Pota-Pox, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.
  6. The following maximum spacings shall be provided for supports:

#### MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

Nominal Pipe or Tube Size	Copper Tubing			PVC/CPVC Pipe (See Note 2) ft
	Water Service ft	Vapor or Air Service ft	Ductile Iron (See Note 1) ft	
1/4	5	5		
3/8	5	6		Continuous
1/2	5	6		Continuous
3/4	5	7		Continuous
1	6	8		4
1 1/4	7	9		4
1 1/2	8	10		4
2	8	10		4
2 1/2	9	10		4



Nominal Pipe or Tube Size	Copper Tubing			PVC/CPVC Pipe (See Note 2) ft
	Water Service ft	Vapor or Air Service ft	Ductile Iron (See Note 1) ft	
3	10	10		4
4	10	10	10	4
5	10	10	10	4
6	10	10	10	9
8	10	10	10	9
10	10	10	10	10
12	10	10	10	10
14			10	10
16			10	10
18			10	10
20			10	
24			10	
30			10	
36			10	
42			10	

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

Note 2: Spacing is based on Schedule 80 at 100°F. For Schedule 40 or higher temperatures, provide shorter span. Consult local plumbing code and manufacturer's recommendations as required. Minimum spacing requirements shall govern.

7. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
8. Provide saddles or shields under or around piping between hanger and supports for all insulated piping to prevent crushing of insulation. Provide stainless steel pipe shields under aeration stainless steel piping to prevent indentation of piping from the support or clamp.
9. Spacing for stainless steel air piping supports shall be a maximum of 16 feet for 6-inch diameter and above piping. Pipe slides, Anvil Figure 257, Type 3, B-line, or equal, in stainless steel shall be used on pipe support brackets where movement due to pipe expansion is anticipated. Expansion joints shall be used to prevent excessive pipe stress. Clamps or supports in contact with the stainless steel piping or as indicated shall be stainless steel.
10. Anchored supports shall include a stainless steel U-bolt and nuts bolted to the wall bracket.
11. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings, and floors to permit access for covering of pipe and painting work. Care shall be taken in laying out piping so that there is no interference with the proper

location of piping for other purposes or other equipment and shall be run with regard to the requirements of each service.

12. Piping shall not interfere with headroom or clear floor space. Unless otherwise shown, piping shall run exposed in buildings, except in finished areas. Unless otherwise shown, small water piping in finished areas shall be concealed in interior walls, above suspended ceilings, or under floors where possible. Water piping shall not be installed in exterior walls, unless otherwise shown or noted on the drawings. Joints shall not be used under floor slabs. Unless otherwise shown, piping under floor slabs shall clear floor slabs or footings by a minimum of 6 inches. Pipes under floors shall have a minimum of 6 inches of sand cover. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
  13. Except for flanged piping, an ample number of standard weight ground joint unions and a shutoff valve shall be provided in all pipelines and at all equipment. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
  14. The appropriate number, size, and lengths of spool pieces and flange fillers needed for plumbing and leveling any existing piping shall be included in the price bid.
  15. The locations and elevations of existing piping are approximate. Any changes in the pipe location or elevation shall be reviewed by ENGINEER.
  16. CONTRACTOR shall submit shop drawings showing new pipe routing and existing pipe removal. CONTRACTOR shall be responsible for final pipe routing and shall route new piping as required to minimize conflicts. Piping shown on the drawings is approximate only. Not all existing piping, conduit, equipment, etc., are shown on the drawings. CONTRACTOR shall field-verify locations. CONTRACTOR shall reroute existing piping, conduit, etc., as indicated or as required to install new piping or equipment. CONTRACTOR shall remove and relocate existing pipe supports as required to install new piping. CONTRACTOR shall provide all piping, fittings, flange fillers, and other appurtenances as required to provide functional system at no additional cost to OWNER.
- B. Plug Valve Installation: Whenever possible, CONTRACTOR shall install plug valves shaft in horizontal and plug above flowline when in the open position. Valve installation shall be in accordance with manufacturer's requirements.
- C. Wall and Other Pipe Penetrations:
1. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the drawings.
  2. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping, unless otherwise shown on the drawings. The sleeve diameter shall not exceed the pipe o.d. plus 2 inches (or the pipe flange o.d. plus 1 inch, as applicable), unless otherwise shown on drawings. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with a mechanical seal. Sleeves shall be steel unless noted otherwise and shall include minimum 1-inch waterstop. For copper pipe, provide an elastomeric sleeve on pipe where it passes through walls or slabs.
  3. Where plain wall pipes are shown or indicated on the drawings, CONTRACTOR may substitute a flanged end wall pipe, if desired, for the purposes of pressure testing specified herein.

4. Where pipe passes through nonwatertight walls, the annular space shall be grouted full. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation. The annular space shall remain open, except the annular space between a rated space (example—Class 1, Division 1, Group D hazardous location) and a nonrated space shall be sealed with a mechanical seal.
5. Where pipes pass through a roof, they shall be run through an approved roof penetration with flashing and counter flashing.
6. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the member, unless otherwise shown on the drawings. The annular space between the concrete and pipe shall be sealed with a mechanical seal. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and annular space between the concrete and the pipe shall be grouted full (walls or floors at rated spaces) or remain open (floors at nonrated spaces). Prior to any coring, CONTRACTOR shall locate reinforcing steel in the member and shall consult with ENGINEER to determine optimal location for the core. Plug abandoned pipes and wall pipes, after pipe and fittings removal flush to the concrete surface, with nonshrink grout, to achieve a watertight seal.
7. Where pipes pass through fire-rated walls, floors, ceilings, or other assemblies, the required firestopping materials shall be provided.
8. Nonshrink grout shall be as specified in Division 03.
9. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the drawings or specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case where such cutting or core drilling is necessary shall reinforcing rods be cut or disturbed without notifying ENGINEER. All openings for pipe work shall be neatly patched in a workmanlike manner.
10. Rough openings in wet well walls shall be provided to install force main discharge piping. Opening shall be minimum necessary to provide for nominal adjustments of pipe installation to eliminate the need for special flanges or sleeves in the wet well to allow for laying length adjustments. After piping is installed and properly supported, opening shall be filled with nonshrink grout formed to the wall surfaces.

### 3.03 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price Bid.
- B. All work shall be inspected, tested, and approved by the appropriate authorities and in accordance with federal, state, and local rules and regulations. All work shall also be tested as specified in this section. Unless indicated by ENGINEER in writing before testing begins, all tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. All new piping shall be tested. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
- D. All piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities

necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.

- E. Pressure Tests: The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids, such as SCM/WAS, shall be tested at the higher test pressure.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
Pump Discharge Piping	150	Water	"A" <sup>(1)</sup>

<sup>1</sup> Leakage allowance Designation "A" shall mean zero leakage.

### 3.04 DEMOLITION

- A. All interior piping removals, including appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Any change in pipe location or elevation shall be reviewed by ENGINEER.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.
- D. It is the responsibility of CONTRACTOR to remove piping and appurtenances, as specified and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

END OF SECTION

**SOILS INFORMATION**



Construction • Geotechnical  
Consulting Engineering/Testing

July 3, 2017  
C17051-13

Mr. Mark Moder, P.E.  
City of Madison – Engineering Department  
210 Martin Luther King, Jr. Blvd., Room 115  
Madison, WI 53703

Re: Geotechnical Exploration Report  
Proposed Thurber Lift Station Replacement  
Blooming Grove, Wisconsin

Dear Mr. Moder:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the geotechnical exploration for the project referenced above. The purpose of this exploration program was to evaluate the subsurface conditions at the location of the proposed lift station and to provide geotechnical recommendations regarding wet well and valve vault design and construction. An electronic copy of this report is provided for your use, and a paper copy can be provided upon request. An electronic copy is also being forwarded to Paul Dries at Strand Associates.

### **PROJECT AND SITE DESCRIPTION**

We understand that a new canned lift station and/or a new valve vault are planned adjacent to the existing pump station, which is to remain in place. The lift station and valve vault would likely extend to depths of about 20 ft and 10 ft, respectively, below ground surface. A new prefabricated, single story control building, with a footprint measuring approximately 10 ft by 10 ft in plan, may also be placed on site. The control building would be supported by standard perimeter frost wall footings.

Based on the above, the base slab of the lift station is assumed to be near EL 833± ft, and the base of the valve vault near EL 843 ft. Both structures are anticipated to consist of manhole-type prefabricated steel sections.

An existing pump station currently occupies the site. The planned new lift station will likely be located adjacent to the existing pump station; the bottom of which is reportedly at a depth of approximately 20.5 ft below existing grade. Asphalt pavement covers the northern portion of the site, with grass lawn over the remainder.

### **SUBSURFACE CONDITIONS**

The subsurface exploration consisted of drilling one Standard Penetration Test (SPT) soil boring (B-1) to a planned depth of 40 ft below existing site grade at a location selected by the City and located in the field by CGC. After completion of drilling, a second boring was drilled without sampling 2 ft west of B-1 to a depth of 10 ft and a 1-in. diameter temporary PVC monitoring well was installed in the borehole to allow

Mr. Mark Moder, P.E.  
City of Madison – Engineering Department  
July 3, 2017  
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for an extended/delayed water level. The borings were drilled on June 7, 2017 by Badger State Drilling (under subcontract to CGC) using an ATV-mounted rotary D-50 drill rig equipped with hollow-stem augers and an automatic SPT hammer. The boring location is shown in plan on the Soil Boring Location Exhibit attached in Appendix B. The ground surface elevation at the boring location was estimated from digital topographical information available via the Dane County DciMap Application and should thus be considered approximate.

The subsurface profile in the boring (B-1) can be described by the following strata (in descending order):

- 6 in. of *topsoil fill*; over
- About 5.5 ft of *fill* consisting of a combination of loose silt with sand and gravel, and medium stiff to very stiff lean clay intermixed with sand and gravel; followed by
- Loose to medium dense *fine to medium sand* with varying silt and gravel content, to the maximum depth explored.

The percent passing the No. 200 U.S. standard sieve (P200) of the sand layers was determined to be 17.8% near 6 ft below grade; 26.5% near 15 ft below grade and 6.9% near 35 ft below grade. The resulting USCS classifications of the test samples range from SP-SM to SM. The particle size distribution test reports are included in Appendix B.

The samples were screened for volatile organics with a Photoionization Detector (PID) by Seymour Environmental personnel under subcontract to CGC. Screening results (in ppm) are indicated on Table 1 attached in Appendix E.

Groundwater was encountered in the boring approximately 7 ft below existing site grade (approximately 846 ft) during drilling. The water level was 7.8 ft below existing grade (EL 845.2 ft) within the temporary well about 24-hours after drilling. Groundwater levels should be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, nearby river and lake levels as well as other factors. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Log attached in Appendix B.

## DISCUSSION AND RECOMMENDATIONS

Based on the subsurface exploration and project information, it is our opinion that a lift station near the boring location can be constructed using typical excavation and earth retention techniques provided appropriate dewatering measures are implemented to adequately control groundwater. Some undercutting and/or subgrade stabilization should be anticipated, especially if an adequate dewatering effort is not in place prior to excavation. Our design and construction recommendations for site preparation and foundations are presented in the following subsections. Additional information regarding the conclusions

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1. Wet Well & Valve Vault Excavation

After removal of topsoil, vegetation and trees, excavation to the base slab elevation for the wet well and vault may proceed. Since the excavation will be approximately 20 ft in depth for the wet well, the excavation should be designed by an appropriately qualified registered professional engineer. The method of excavation sloping and earth retention will depend on the proximity of the excavation to the surrounding pavement and structures, and the means and methods are the responsibility of the contractor. We recommend that a pre-condition survey of the surrounding structures be completed prior to construction.

Since the excavation may be bounded on three sides by pavement and/or nearby structures, an earth retention system will likely be required. It appears that sheet piling or soldier pile/wood lagging systems with tiebacks or internal bracing would likely be applicable. The dewatering system should be designed in conjunction with the earth retention system, and drainage provisions (e.g., three-dimension drainage board) should be provided behind the retention system to prevent the development of hydrostatic pressure. Earth retention systems should be designed by an appropriately qualified professional engineer.

Conventional sloping may be possible for part of the southern portion of the excavation where lawn exists south of the proposed lift station. The prevalent sand soils with some silt (denoted as SM on the boring log) are generally classified as OSHA "Type B" soils where minimum slopes of 1H:1V (or flatter) are typically acceptable assuming that the soils are above the water table or effectively dewatered. Note that the shallow fill soils are likely OSHA "Type C" soil where 1.5H:1V (or flatter) sloping is required. Therefore, the upper approximately 5.5 ft of the excavation may require flatter side slopes, but the excavation slope determination should be made by the excavation design engineer, with the soil conditions evaluated by a competent person completing the excavation in the field. Excavation slopes should be protected from erosion using diversion berms at the top and plastic (e.g., visqueen) on the excavation face.

Below about 7 to 8 ft, groundwater was encountered, so dewatering will likely be required in advance of excavation to reduce the risk of excavation instability. Based on groundwater drawdowns in excess of 2 ft, we anticipate that dewatering with well points or deep wells will be required. To prevent uplift at the base of the excavation, we recommend that the wells or well points intercept the more permeable sand strata and extend to a depth of at least 32 ft. The discharge from the dewatering system should flow into a sedimentation basin prior to discharging to check for excessive sediment, which would suggest improperly sized well screens. Proper well screens are required to prevent the loss of soil and potential settlement of surrounding structures. Supplemental dewatering using submersible pumps in a clear stone layer at the bottom of the excavation may be required. *Dewatering means and methods are the responsibility of the contractor.*

We recommend including a minimum 12-in. thick layer of compacted crushed clear stone at the base of the wet well excavation to create fairly uniform bearing conditions for the base slab. The stone should be





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enveloped in non-woven geotextile fabric (Mirafi 160N or equivalent). Minor sumping can also be accomplished from the clear stone layer as a supplement to the primary well point/deep well system, as mentioned earlier.

Once the wet well sections are installed, the annular space around the manhole units should be backfilled. On the sides of the manhole where overlying structures are not present and some settlement at the surface will be tolerable, the wet well can be backfilled with smaller size clear stone or pea gravel. Note that if uncompacted material is used as backfill, there is a risk that settlement may occur which can be minimized using vibratory methods during placement. Where overlying structures will be constructed and settlement needs to be minimized, backfilling in areas with limited space can be accomplished with flowable fill or similar low strength cementitious material. If space allows for compaction equipment, granular soil can be used as backfill in the upper part of the excavation. In pavement and landscape areas, the granular soil should be compacted to a minimum of 90% compaction (based on modified Proctor methods – ASTM D 1557) from the bottom of the excavation to within 3 ft of the surface, with 95% compaction in the upper 3 ft in pavement areas. *Where structures (e.g., valve vault) will be supported on the granular backfill, 95% compaction is recommended from the bottom of the excavation up to the foundation grade.*

**2. Foundation/Base Slab Design**

In our opinion, the wet well base should be supported on a stone layer above the medium dense sand soil, and the valve vault base will be supported on natural granular soils or engineered granular backfill. The proposed control building can be supported on reinforced concrete spread footing foundations bearing on the native medium dense granular soils, or compacted granular fill. *Based on the presence of existing fill and loose native sand soils to a depth of about 5.5 ft below existing grade, some undercutting will likely be required below perimeter frost depth footing grade.* The following parameters should be used for foundation design:

- Maximum net allowable bearing pressure:
  - Wet well and valve vault base: 2,500 psf
  - Control building frost depth footings: 1,500 psf
- Minimum foundation widths:
  - Continuous wall footings: 18 in.
  - Column pad footings: 30 in.

We recommend that CGC be retained during construction to check that footing/base slab subgrades are suitable for their design bearing pressure or recommend corrective measures, if necessary. If loose or disturbed granular soils areas are detected, they should be recompacted or stabilized with clear stone that is compacted into the subgrade until deflection ceases. Soils that cannot be adequately recompacted should be undercut and replaced with engineered granular soil. Where undercutting is required, the base of the undercut excavations should be widened beyond the footing edges at least 0.5 ft in each direction



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for each foot of undercut depth for stress distribution purposes. Grade should be restored using granular fill compacted to 95 percent compaction (ASTM D 1557) or well-compacted 3-in. dense graded base or clear stone.

For footing excavations in granular soil, we recommend using a smooth-edged backhoe bucket. Further, sand footing subgrade soils that are at least 1 ft above the groundwater should be recompacted with large vibratory plate compactor to densify soils loosened/disturbed during excavation. Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should not exceed 1.0 and 0.5 in., respectively.

**3. Below-Grade Wet Well/Valve Vault Structure Design Parameters**

We assume that the wet well and/or valve vault structure will consist of a cylindrical prefabricated steel manhole-type unit supported on a base slab located about 20 ft or 10 ft, respectively, below existing grade. Assuming that the excavation is backfilled with granular soils, similar to those encountered in the boring, the following parameters should be used for the design of the structure(s):

**Table 1 – Lift Station Design Parameters (Granular Backfill)**

Total Unit Weight of Soil Backfill (pcf):	125
Buoyant Unit Weight of Soil Backfill (pcf):	63
At-Rest Lateral Earth Pressure Coefficient ( $K_0$ ):	0.5
Active Lateral Earth Pressure Coefficient ( $K_a$ ):	0.3

The lateral earth pressure coefficients assume that granular material is used as backfill and compacted to a minimum of 95 percent of modified Proctor (ASTM D 1557). Hydrostatic pressures should be included for walls located below the water table, if applicable. Additionally, the buoyant unit weight should be used for soils below the water table for calculating resistance to hydrostatic uplift. If the base slab extends beyond the lift station walls, the dead weight of soil (submerged unit weight below the water table) located directly above the slab can be included in uplift resistance.

Where the sides of the deep wet well and/or valve vault excavation will encroach upon the zone of influence of existing or the proposed structures (assume a slope of 0.5H:1V from the outside edge of the foundation) that portion/side of the excavation should be backfilled with granular material compacted to a minimum of 95% modified Proctor or with clear stone or 3-in. dense graded base placed in maximum 12-in. loose lifts and compacted with a heavy vibratory compactor until deflection ceases.

**4. Control Building Floor Slab**

We anticipate that the soils exposed at floor slab subgrade within the proposed control building will consist of existing fill and/or compacted granular backfill. The slab subgrade should be recompacted

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with a smooth-drum compactor and then proof-rolled with a loaded truck or other heavy rubber tired piece of construction equipment to check for loose/yielding areas. If loose/yielding areas are detected, they should be undercut/removed and replaced with granular backfill that is compacted to at least a level of 95% compaction based on modified Proctor methods (ASTM D1557). As an alternative, the soft/yielding areas could be stabilized with compacted 3-in. dense graded base (DGB).

Fill placement to establish design grades can then begin, where necessary. We recommend using granular soils as fill within the building footprint, which should be compacted to a minimum of 95% compaction based on modified Proctor methods (ASTM D1557). Periodic field density tests should be taken by CGC to document that the required compaction levels are being achieved.

In our opinion a subgrade modulus of 100 pci may be used in design assuming the presence of a firm stable subgrade. To serve as a capillary break, the final 4 to 6 in. of soil placed below the slab should consist of well-graded sand or gravel with no more than 5 percent by weight passing a No. 200 U.S. standard sieve. (Note that some structural engineers require a 4 to 6 in. thick layer of dense graded base (e.g., 1.25-in. crushed aggregate base course) below the slab to increase the subgrade modulus immediately below the slab.) The slab should be structurally separate from the foundations and have construction joints and wire mesh for crack control.

#### 5. Seismic Design Category

In our opinion, the average soil/rock properties in the upper 100 ft of the site (based on N-values generally greater than 15 blows/ft) can be characterized as a stiff profile. This characterization would place the site in Site Class D for seismic design according to the International Building Code (see Table 1613.5.2).

### CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil related difficulties which could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of the on-site soils, we recommend that general site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.
- Earthwork construction during late fall through early spring could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.



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- If the schedule requires that construction proceed during adverse weather conditions, typically encountered during fall through spring, the contingency for undercutting/stabilizing disturbed soils should be increased.
- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards. Excavations deeper than 20 ft should be designed by an appropriately qualified professional engineer. Dewatering and earth retention will be important considerations during excavation.
- When excavating adjacent to the existing structures, take care to avoid undermining the existing foundations. Where excavations will encroach upon existing foundations or utilities that will remain, earth retention or underpinning will likely be required to support the existing structures. We can provide additional consultation, if desired.
- Based on observations made during the field exploration, groundwater infiltration into excavations should be expected and dewatering considerations were previously discussed. Additional water accumulating at the base of excavations as a result of precipitation or seepage should be controlled and quickly removed using pumps operating from filtered sump pits.

#### **RECOMMENDED CONSTRUCTION MONITORING**

The quality of the foundation and pavement subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation construction proceeds in accordance with our recommendations, the following operations should be monitored by CGC:

- Topsoil stripping/subgrade proof-rolling within the construction areas;
- Fill/backfill placement and compaction;
- Foundation excavation/subgrade preparation; and
- Concrete placement.

\* \* \* \*

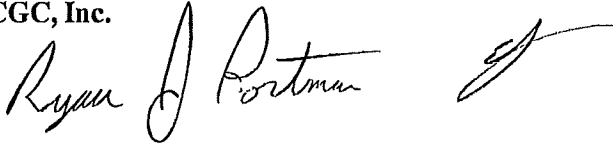
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It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.



Ryan J. Portman, P.E.  
Consulting Professional



Michael N. Schultz, P.E.  
President/Senior Consulting Professional

Encl.: Appendix A - Field Exploration  
Appendix B - Soil Boring Location Exhibit  
Logs of Test Boring (1)  
Log of Test Boring-General Notes  
Unified Soil Classification System  
Particle Size Distribution Test Reports (2)  
Appendix C - Document Qualifications  
Appendix D - Recommended Compacted Fill Specifications  
Appendix E - Photoionization Detector (PID) Readings

cc: Paul Dreis, Strand Associates

**APPENDIX A**

**FIELD EXPLORATION REPORT**

## APPENDIX A

### FIELD EXPLORATION

One Standard Penetration Test (SPT) soil boring was drilled to a planned depth of 40 ft below existing site grade at a location selected and located in the field by CGC. After completion of drilling, a second boring was drilled without sampling to a depth of 10 ft and a 1-in. diameter temporary PVC monitoring well was installed in the borehole. The boring was drilled on June 7, 2017 by Badger State Drilling (under subcontract to CGC) using an ATV-mounted rotary D-50 drill rig equipped with hollow-stem augers and an automatic SPT hammer. The initial boring location is shown in plan on the Soil Boring Location Exhibit attached in Appendix B. The ground surface elevation at the boring location was interpolated from DCiMap.

Standard penetration test (SPT) soil samples were obtained at 2.5-foot intervals to 10 ft and then at 5-ft intervals to the termination depth. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

The boring is extended downward, between samples, by a hollow-stem auger to a depth of 10 ft; then by mud rotary drilling techniques (3 7/8-in. roller bit and drilling mud) to the maximum depth explored.

2. Standard Penetration Test and Split-Barrel Sampling of Soils  
(ASTM Designation: D 1586)

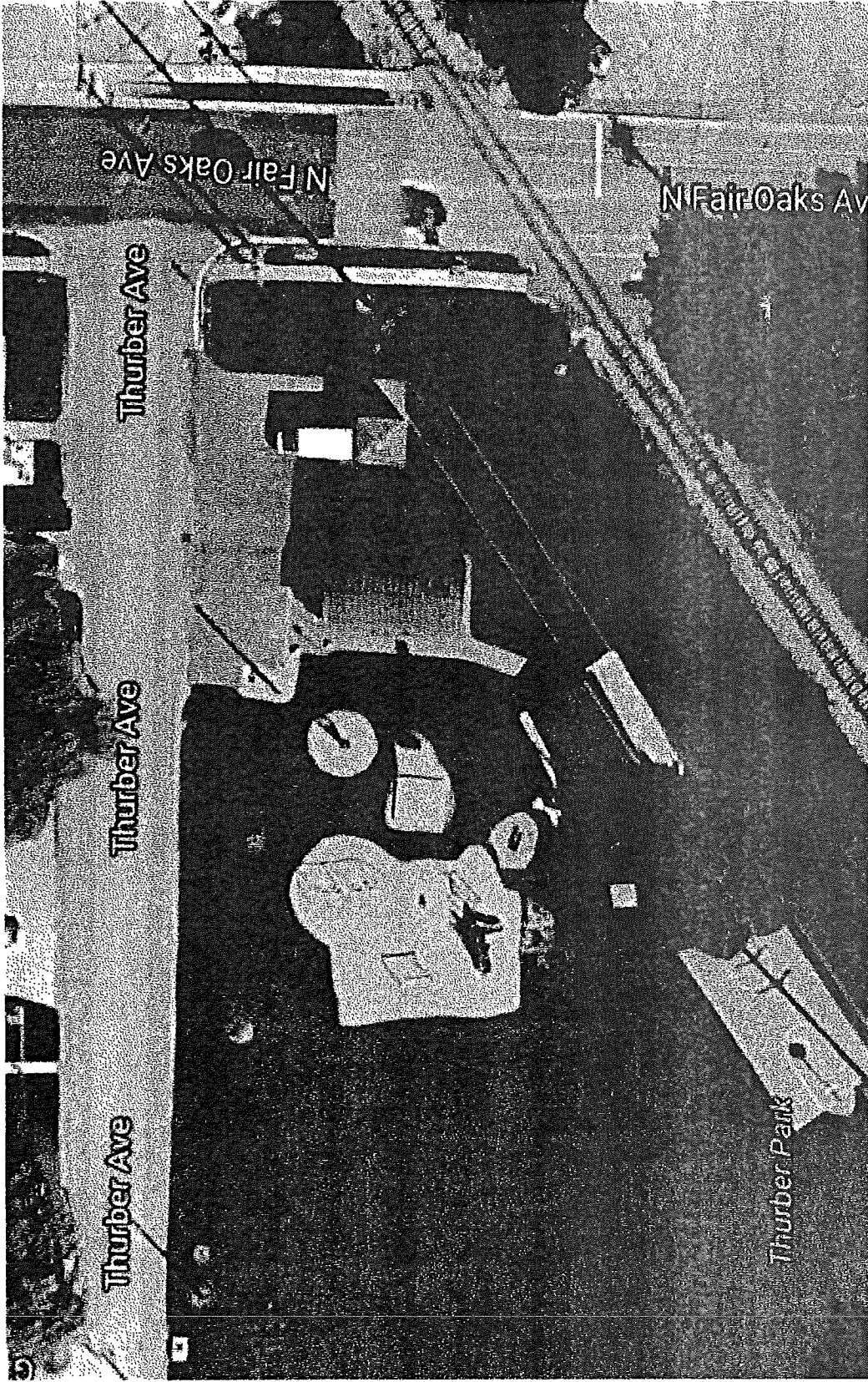
This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of boring and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Screening of the soil samples for possible environmental contaminants was completed by Seymour Environmental (under subcontract to CGC).* Water level observations were made in the boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the boring was backfilled with bentonite (where required) to satisfy WDNR regulations and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final log prepared by the engineer and a description of the Unified Soil Classification System are presented in Appendix B.


**APPENDIX B**

**BORING LOG LOCATION MAP  
LOGS OF TEST BORING (1)  
LOG OF TEST BORING – GENERAL NOTES  
UNIFIED SOIL CLASSIFICATION SYSTEM  
PARTICLE SIZE DISTRIBUTION TEST REPORTS (2)**





**Legend**

 Denotes Boring Location

**Notes**

1. Soil boring performed by Badger State Drilling in June 2017
2. Boring location is approximate.



Scale: Reduced

Date:  
6/2017

Job No.  
C17051-13



Soil Boring Location Exhibit  
Thurber Lift Station Replacement  
Blooming Grove, WI



# LOG OF TEST BORING

Project **Thurber Lift Station Replacement**  
 Location **Madison, WI**

Boring No. **1**  
 Surface Elevation (ft) **853±**  
 Job No. **C17051-13**  
 Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
1	4	M	7	0-6	6 in. TOPSOIL FILL					
2	10	M	13	6-10	FILL: Loose Brown Silt with Sand and Gravel					
3	12	W	5	10-12	FILL: Medium Stiff to Very Stiff, Brown Lean Clay with Sand and Gravel	(1.0-2.0)				
4	12	W	9	12-10	Loose, Brown Fine to Medium SAND, Some Silt, Trace Gravel (SM)					
				10-10	%P200 = 17.8 (For Combined Samples 3 and 4)					
5	6	W	21	15-10	Loose to Medium Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)					
				15-15	%P200 = 26.5 (For Combined Samples 5 and 6)					
6	8	W	8	20-8						
7	4	W	12	25-4						
8	6	W	35	30-6	Dense Near 30 ft					
9	12	W	28	35-12	Medium Dense, Brown Fine to Medium SAND, Little Silt (SP-SM)					
				35-35	%P200 = 6.9 (For Combined Samples 9 and 10)					
10	10	W	28	40-10						
				40-40	End of Boring at 40 ft					
				45-45	Backfilled with Bentonite Slurry and Chips Moved 2 ft West, Blind Drilled to 10 ft and Set Temp Well at 9.5 ft					
				50-50	Backfilled with Bentonite Chips After 24 Hour Water Level and Abandonment					

WATER LEVEL OBSERVATIONS	
While Drilling $\nabla$ 7.0'	Upon Completion of Drilling _____
Time After Drilling _____	24 Hours _____
Depth to Water _____	7.8' $\nabla$
Depth to Cave in _____	_____

GENERAL NOTES	
Start 6/7/17	End 6/7/17
Driller BSD	Chief DB Rig D-50
Logger CD	Editor ESF
Drill Method 4-1/4" HSA to 10'; 3 7/8"	
RB with Mud to 40'; Autohammer	

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**LOG OF TEST BORING**  
*General Notes*

**DESCRIPTIVE SOIL CLASSIFICATION**

Grain Size Terminology

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders.....	Larger than 12" .....	Larger than 12"
Cobbles.....	3" to 12" .....	3" to 12"
Gravel: Coarse.....	¾" to 3" .....	¾" to 3"
Fine.....	4.76 mm to ¾" .....	#4 to ¾"
Sand: Coarse.....	2.00 mm to 4.76 mm.....	#10 to #4
Medium.....	0.42 to mm to 2.00 mm.....	#40 to #10
Fine.....	0.074 mm to 0.42 mm.....	#200 to #40
Silt.....	0.005 mm to 0.074 mm .....	Smaller than #200
Clay.....	Smaller than 0.005 mm .....	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

General Terminology

**Physical Characteristics**  
 Color, moisture, grain shape, fineness, etc.  
**Major Constituents**  
 Clay, silt, sand, gravel  
**Structure**  
 Laminated, varved, fibrous, stratified, cemented, fissured, etc.  
**Geologic Origin**  
 Glacial, alluvial, eolian, residual, etc.

Relative Density

**Term**      "N" Value  
 Very Loose..... 0 - 4  
 Loose..... 4 - 10  
 Medium Dense.....10 - 30  
 Dense.....30 - 50  
 Very Dense.....Over 50

Relative Proportions Of Cohesionless Soils

Proportional Term	Defining Range by Percentage of Weight
Trace.....	0% - 5%
Little .....	5% - 12%
Some .....	12% - 35%
And.....	35% - 50%

Consistency

Term	q <sub>u</sub> -tons/sq. ft
Very Soft.....	0.0 to 0.25
Soft.....	0.25 to 0.50
Medium.....	0.50 to 1.0
Stiff.....	1.0 to 2.0
Very Stiff.....	2.0 to 4.0
Hard.....	Over 4.0

Organic Content by Combustion Method

Soil Description	Loss on Ignition
Non Organic.....	Less than 4%
Organic Silt/Clay.....	4 - 12%
Sedimentary Peat.....	12% - 50%
Fibrous and Woody Peat...	More than 50%

Plasticity

Term	Plastic Index
None to Slight.....	0 - 4
Slight.....	5 - 7
Medium.....	8 - 22
High to Very High ..	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

**SYMBOLS**

Drilling and Sampling

- CS – Continuous Sampling
- RC – Rock Coring: Size AW, BW, NW, 2"W
- RQD – Rock Quality Designation
- RB – Rock Bit/Roller Bit
- FT – Fish Tail
- DC – Drove Casing
- C – Casing: Size 2 ½", NW, 4", HW
- CW – Clear Water
- DM – Drilling Mud
- HSA – Hollow Stem Auger
- FA – Flight Auger
- HA – Hand Auger
- COA – Clean-Out Auger
- SS - 2" Dia. Split-Barrel Sample
- 2ST – 2" Dia. Thin-Walled Tube Sample
- 3ST – 3" Dia. Thin-Walled Tube Sample
- PT – 3" Dia. Piston Tube Sample
- AS – Auger Sample
- WS – Wash Sample
- PTS – Peat Sample
- PS – Pitcher Sample
- NR – No Recovery
- S – Sounding
- PMT – Borehole Pressuremeter Test
- VS – Vane Shear Test
- WPT – Water Pressure Test

Laboratory Tests

- q<sub>a</sub> – Penetrometer Reading, tons/sq ft
- q<sub>u</sub> – Unconfined Strength, tons/sq ft
- W – Moisture Content, %
- LL – Liquid Limit, %
- PL – Plastic Limit, %
- SL – Shrinkage Limit, %
- LI – Loss on Ignition
- D – Dry Unit Weight, lbs/cu ft
- pH – Measure of Soil Alkalinity or Acidity
- FS – Free Swell, %

Water Level Measurement

- ∇ - Water Level at Time Shown
- NW – No Water Encountered
- WD – While Drilling
- BCR – Before Casing Removal
- ACR – After Casing Removal
- CW – Cave and Wet
- CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

# CGC, Inc.

Madison - Milwaukee

# Unified Soil Classification System





## UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

### COARSE-GRAINED SOILS

(more than 50% of material is larger than No. 200 sieve size)





#### Clean Gravels (Less than 5% fines)

**GRAVELS**  
More than 50% of coarse fraction larger than No. 4 sieve size

	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
<b>Gravels with fines (More than 12% fines)</b>		
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures






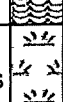

#### Clean Sands (Less than 5% fines)

**SANDS**  
50% or more of coarse fraction smaller than No. 4 sieve size

	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
<b>Sands with fines (More than 12% fines)</b>		
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures

### FINE-GRAINED SOILS

(50% or more of material is smaller than No. 200 sieve size.)

<b>SILTS AND CLAYS</b> 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, lean clays
		OL	Organic silts and organic silty clays of low plasticity
<b>SILTS AND CLAYS</b> Liquid limit 50% or greater		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
<b>HIGHLY ORGANIC SOILS</b>		PT	Peat and other highly organic soils

## LABORATORY CLASSIFICATION CRITERIA

GW  $C_u = \frac{D_{60}}{D_{10}}$  greater than 4;  $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$  between 1 and 3

GP Not meeting all gradation requirements for GW

GM Atterberg limits below "A" line or P.I. less than 4  
 GC Atterberg limits above "A" line or P.I. greater than 7  
 Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols

SW  $C_u = \frac{D_{60}}{D_{10}}$  greater than 4;  $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$  between 1 and 3

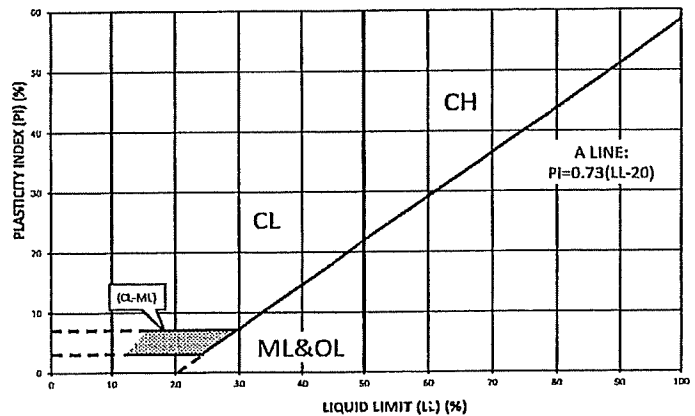
SP Not meeting all gradation requirements for GW

SM Atterberg limits below "A" line or P.I. less than 4  
 SC Atterberg limits above "A" line with P.I. greater than 7  
 Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols

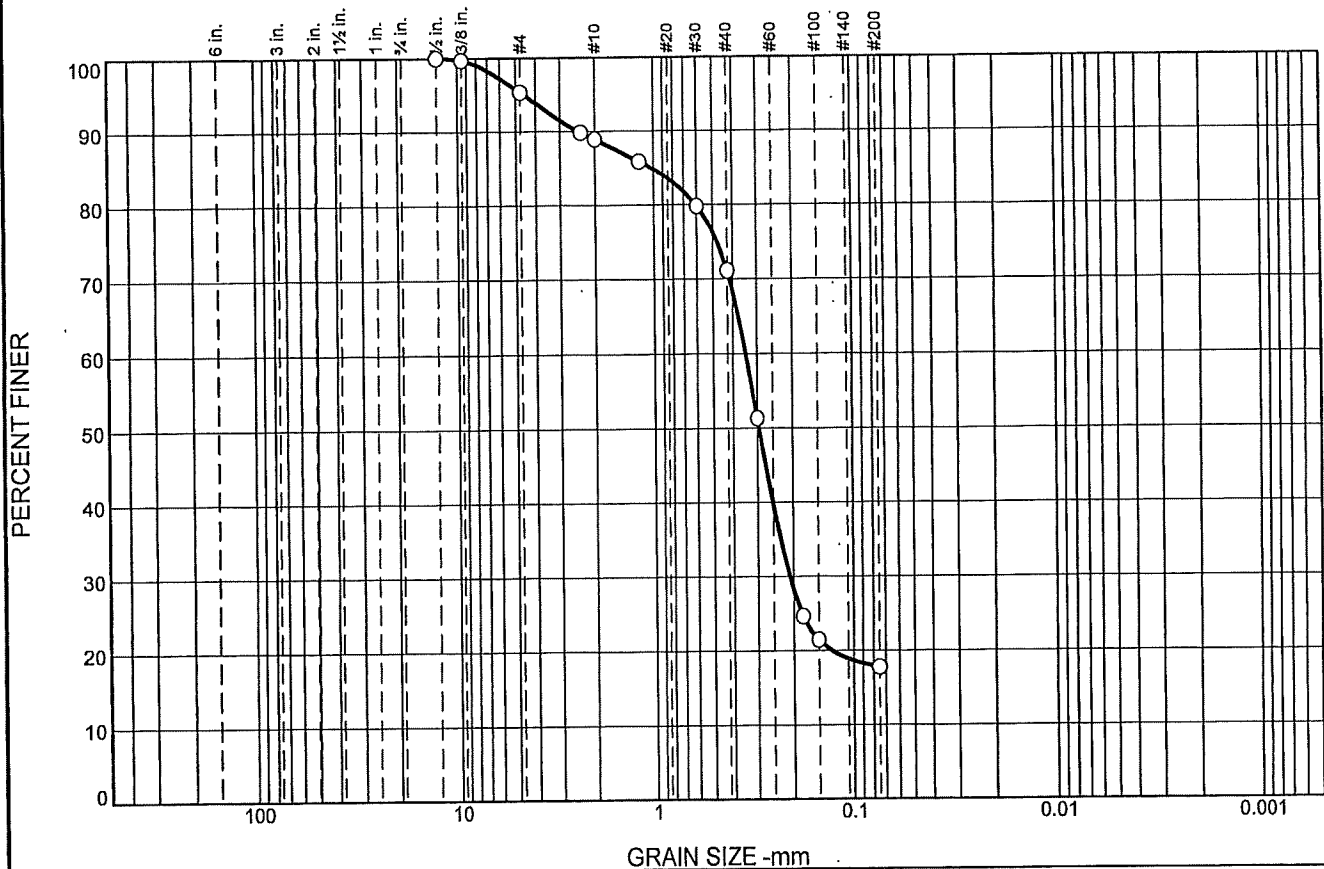
Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

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

### PLASTICITY CHART



# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.6	6.5	17.8	53.3	17.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2	100.0		
3/8	99.7		
#4	95.4		
#8	89.8		
#10	88.9		
#16	85.8		
#30	79.8		
#40	71.1		
#50	51.3		
#80	24.6		
#100	21.5		
#200	17.8		

**Material Description**

Brown Fine to Coarse Sand, Some Silt, Trace Gravel

**Atterberg Limits**  
 PL=                      LL=                      PI=

**Coefficients**  
 D<sub>90</sub>= 2.4312      D<sub>85</sub>= 1.0314      D<sub>60</sub>= 0.3440  
 D<sub>50</sub>= 0.2939      D<sub>30</sub>= 0.2082      D<sub>15</sub>=  
 D<sub>10</sub>=                      C<sub>u</sub>=                      C<sub>c</sub>=

**Classification**  
 USCS= SM                      AASHTO=

**Remarks**

\* (no specification provided)

Sample Number: B1, S-3 + S-4

Date: 6/14/17



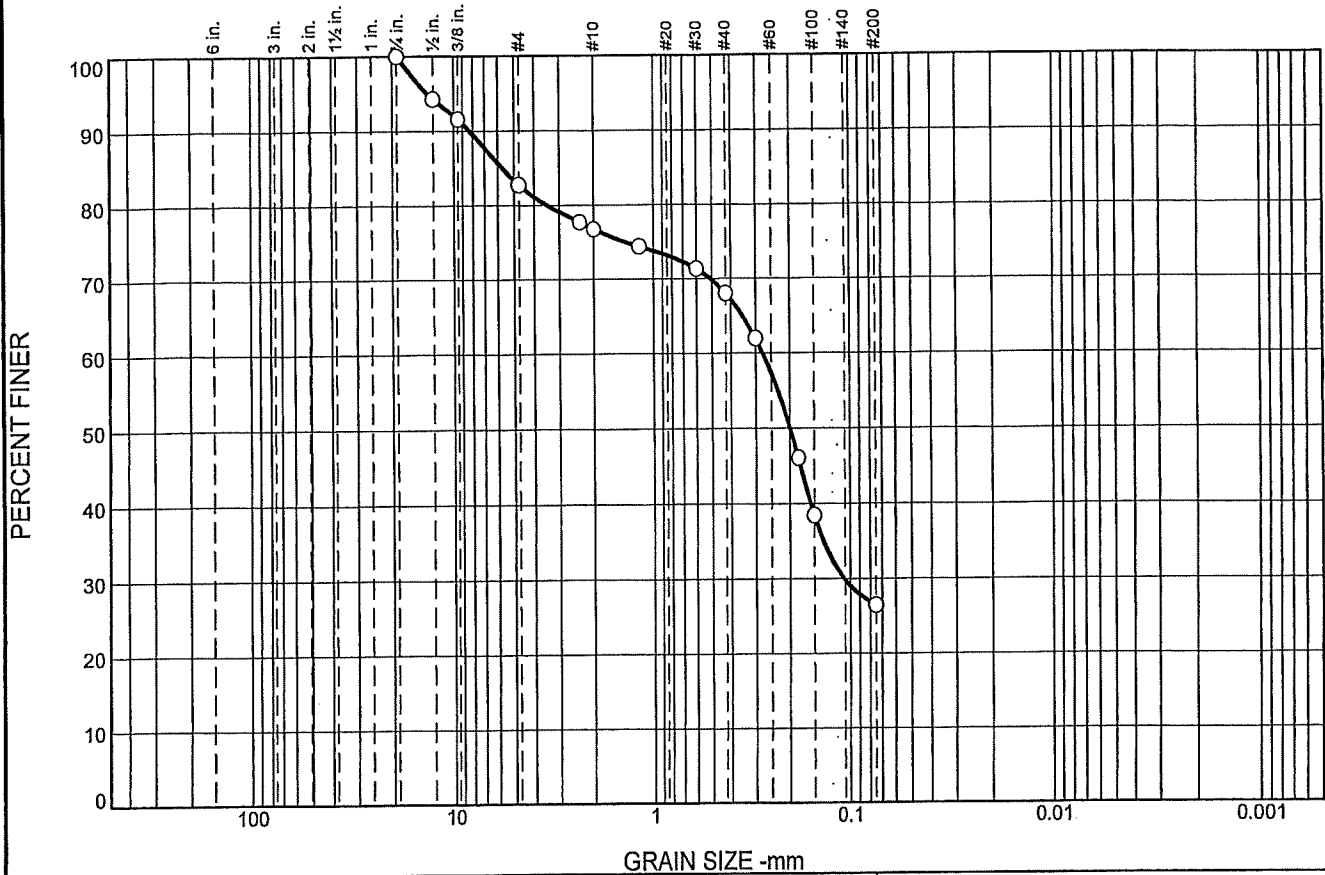
Client: City of Madison  
 Project: Thurber Lift Station Replacement  
 Project No: C17051-13

Figure

Tested By: DRW

Checked By: ESF

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	17.2	6.0	8.8	41.5	26.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	94.3		
3/8	91.6		
#4	82.8		
#8	77.7		
#10	76.8		
#16	74.4		
#30	71.3		
#40	68.0		
#50	62.0		
#80	46.1		
#100	38.5		
#200	26.5		

**Material Description**

Brown Fine to Coarse Sand, Some Silt and Gravel

**Atterberg Limits**

PL=                      LL=                      PI=

**Coefficients**

D<sub>90</sub>= 8.2711              D<sub>85</sub>= 5.7019              D<sub>60</sub>= 0.2759  
D<sub>50</sub>= 0.1989              D<sub>30</sub>= 0.1072              D<sub>15</sub>=  
D<sub>10</sub>=                      C<sub>u</sub>=                      C<sub>c</sub>=

**Classification**

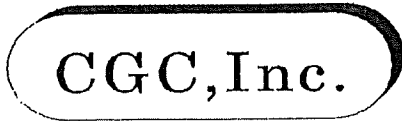
USCS= SM                      AASHTO=

**Remarks**

\* (no specification provided)

Sample Number: B1, S-5 + S-6

Date: 6/16/17



Client: City of Madison  
Project: Thurber Lift Station Replacement

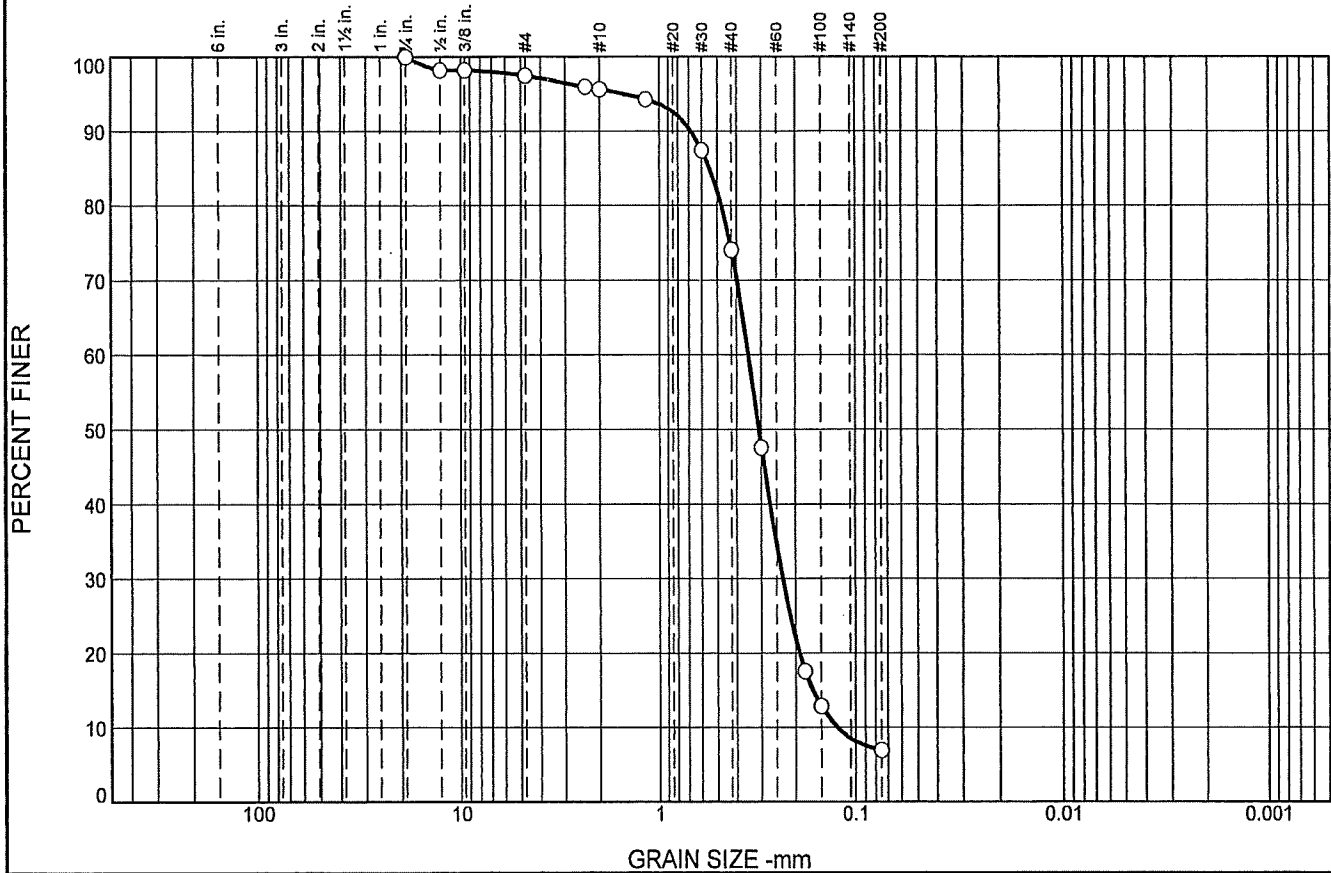
Project No: C17051-13

Figure

Tested By: DRW

Checked By: ESF

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	1.9	21.6	67.1	6.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	98.2		
3/8	98.2		
#4	97.5		
#8	96.0		
#10	95.6		
#16	94.2		
#30	87.4		
#40	74.0		
#50	47.5		
#80	17.5		
#100	12.8		
#200	6.9		

**Material Description**

Brown Fine to Medium Sand, Little Silt, Trace Gravel

**Atterberg Limits**

PL=                      LL=                      PI=

**Coefficients**

D<sub>90</sub>= 0.6851      D<sub>85</sub>= 0.5470      D<sub>60</sub>= 0.3501  
D<sub>50</sub>= 0.3094      D<sub>30</sub>= 0.2336      D<sub>15</sub>= 0.1652  
D<sub>10</sub>= 0.1248      C<sub>u</sub>= 2.81              C<sub>c</sub>= 1.25

**Classification**

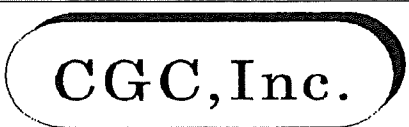
USCS= SP-SM                      AASHTO=

**Remarks**

\* (no specification provided)

Sample Number: B-1; S-9 + S-10

Date: 7/3/17



Client: City of Madison  
Project: Thurber Lift Station Replacement

Project No: C17051-13

Figure

Tested By: DRW

Checked By: KJS

**Table 1**  
**Field Screening Results**  
**CGC**  
**C17051-13**  
**Thurber Lift Station**

Sample I.D.	Depth (feet bgs)	OVM
S-1	1-2.5	16.6
S-2	3.5-5	0.0
S-3	6-7.5	6.9
S-4	8.5-10	5.5
S-5	13.5-15	0.0
S-6	18.5-20	0.1
S-7	23.5-25	0.0
S-8	28.5-30	0.0
S-9	33.5-35	0.0
S-10	38.5-40	0.0

Results in parts per million by volume, calibrated to isobutylene



**APPENDIX C**

**DOCUMENT QUALIFICATIONS**

## APPENDIX C DOCUMENT QUALIFICATIONS

### I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

### II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

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 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. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not informed.*

#### SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *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 OPINION

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 judgement 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 over-rely on the confirmation-dependent recommendations included in your report. *Those confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's confirmation-dependent recommendations if we do not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

#### **A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION**

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront 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. Constructors can also misinterpret a geotechnical engineering report. Confront that risk by having CGC participate in prebid and preconstruction conferences, and by providing geotechnical 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 CONSTRUCTORS A COMPLETE REPORT AND GUIDANCE**

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors 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 constructors have sufficient time to perform additional study. Only then might you be in a position to give constructors 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 constructors 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 engineer's 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.

#### **ENVIRONMENTAL CONCERNS ARE NOT COVERED**

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any environmental 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 environmental 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, many 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 GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE**

Membership in the Geotechnical Business Council (GBC) of Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of GBC, for more information.

Modified and reprinted with permission from:

Geotechnical Business Council  
of the Geoprofessional Business Association  
8811 Colesville Road, Suite G 106  
Silver Spring, MD 20910

**APPENDIX D**

**RECOMMENDED COMPACTED FILL SPECIFICATIONS**

## APPENDIX D

### CGC, INC.

## RECOMMENDED COMPACTED FILL SPECIFICATIONS

### General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

### Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

### Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

### Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

### Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

**Table 1**  
**Gradation of Special Fill Materials**

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
<b>Sieve Size</b>	<b>Percent Passing by Weight</b>							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55			
No. 40			5-20	8-28	10-35	75 (2)		
No. 100						15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

**Notes:**

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction*.
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

**Table 2**  
**Compaction Guidelines**

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
<b>Within 10 ft of building lines</b>		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
<b>Beyond 10 ft of building lines</b>		
Under walks and pavements		
- Less than 2 ft below subgrade	92	95
- Greater than 2 ft below subgrade	90	90
Landscaping	85	90

**Notes:**

1. Based on Modified Proctor Dry Density (ASTM D 1557)

For more location information  
please visit [www.strand.com](http://www.strand.com)

## Office Locations

Brenham, Texas | 979.836.7937

Cincinnati, Ohio | 513.861.5600

Columbus, Indiana | 812.372.9911

Columbus, Ohio | 614.835.0460

Indianapolis, Indiana | 317.423.0935

Joliet, Illinois | 815.744.4200

Lexington, Kentucky | 859.225.8500

Louisville, Kentucky | 502.583.7020

Madison, Wisconsin\* | 608.251.4843

Milwaukee, Wisconsin | 414.271.0771

Phoenix, Arizona | 602.437.3733

\*Corporate Headquarters





Department of Public Works  
**Engineering Division**  
 Robert F. Phillips, P.E., City Engineer  
 City-County Building, Room 115  
 210 Martin Luther King, Jr. Boulevard  
 Madison, Wisconsin 53703  
 Phone: (608) 266-4751  
 Fax: (608) 264-9275  
[engineering@cityofmadison.com](mailto:engineering@cityofmadison.com)  
[www.cityofmadison.com/engineering](http://www.cityofmadison.com/engineering)

**Deputy City Engineer**  
 Gregory T. Fries, P.E.  
**Deputy Division Manager**  
 Kathleen M. Cryan  
**Principal Engineer 2**  
 Christopher J. Petykowski, P.E.  
 John S. Fahrney, P.E.  
 Janet Schmidt, P.E.  
**Principal Engineer 1**  
 Christina M. Bachmann, P.E.  
 Mark D. Moder, P.E.  
 James M. Wolfe, P.E.  
**Facilities & Sustainability**  
 Bryan Cooper, Principal Architect  
**Mapping Section Manager**  
 Eric T. Pederson, P.S.  
**Financial Manager**  
 Steven B. Danner-Rivers

September 3, 2021

**NOTICE OF ADDENDUM  
 ADDENDUM NO. 1  
 CONTRACT NO. 9063**

**THURBER LIFT STATION REPLACEMENT**

Revise and amend the contract document(s) for the above project as stated in this addendum, otherwise, the original document shall remain in effect.

**PAGE A-1, SECTION A: ADVERTISEMENT FOR BIDS AND INSTRUCTIONS TO BIDDERS:**

EDITS TO TABLE ON SHEET A-1:

REMOVE AND REPLACE TABLE WITH:

PROJECT NAME:	THURBER LIFT STATION REPLACEMENT
CONTRACT NO.:	9063
SBE GOAL	3%
BID BOND	5%
SBE PRE BID MEETING	See Pre Bid Meeting info below
PREQUALIFICATION APPLICATION DUE (2:00 P.M.)	9/16/2021
BID SUBMISSION (2:00 P.M.)	9/23/2021
BID OPEN (2:30 P.M.)	9/23/2021
PUBLISHED IN WSJ	8/19/2021, 8/26/2021, 9/9/2021 & 9/16/2021

**SPECIAL PROVISIONS:**

**TECHNICAL SPECIFICATIONS:**

1. DIVISION 01-GENERAL REQUIREMENTS
  - a. Page 01 11 00-2, SECTION 01 11 00-SUMMARY OF WORK, PART 1-GENERAL, Paragraph 1.04.A.5

REMOVE: The following language:

“When flow diversion is in progress, CONTRACTOR shall have a minimum of one worker dedicated full time to operate the pumps.”

**PLANS:**

1. SHEET NO. 6-PUMPING STATION PLANS AND SECTION



REMOVE the following language under item 1, CONSTRUCTION SEQUENCE FOR TRANSITION:

"IN ALL BYPASS PUMPING SITUATIONS, THERE MUST BE SOMEONE ON-SITE AT ALL TIMES DURING BYPASSING TO ENSURE PUMPS ARE OPERATING."

Please acknowledge this addendum on page E1 of the contract documents and/or in Section E: Bidder's Acknowledgement on Bid Express.

Electronic version of these documents can be found on the Bid Express web site at:  
<http://www.bidexpress.com>

If you are unable to download plan revisions associated with the addendum, please contact the Engineering office at 608-266-4751 receive the material by another route.

Sincerely,

*Christy Bachmann* on behalf:  
Robert F. Phillips, P.E., City Engineer

# SECTION A: ADVERTISEMENT FOR BIDS AND INSTRUCTIONS TO BIDDERS

## REQUEST FOR BID FOR PUBLIC WORKS CONSTRUCTION CITY OF MADISON, WISCONSIN

### A BEST VALUE CONTRACTING MUNICIPALITY

PROJECT NAME:	THURBER LIFT STATION REPLACEMENT
CONTRACT NO.:	9063
SBE GOAL	3%
BID BOND	5%
SBE PRE BID MEETING	See Pre Bid Meeting info below
PREQUALIFICATION APPLICATION DUE (2:00 P.M.)	9/16/2021
BID SUBMISSION (2:00 P.M.)	9/23/2021
BID OPEN (2:30 P.M.)	9/23/2021
PUBLISHED IN WSJ	8/19/2021, 8/26/2021, 9/9/2021 & 9/16/2021

SBE PRE BID MEETING: Small Business Enterprise Pre-Bid Meetings are not being held in person at this time. Contractors can schedule one-on-one phone calls with Juan Pablo Torres Meza in Affirmative Action to count towards good faith efforts. Juan Pablo can be reached at (608) 261-9162 or by email, [jtorresmeza@cityofmdison.com](mailto:jtorresmeza@cityofmdison.com).

PREQUALIFICATION APPLICATION: Forms are available on our website, [www.cityofmadison.com/engineering/developers-contractors/contractors/how-to-get-prequalified](http://www.cityofmadison.com/engineering/developers-contractors/contractors/how-to-get-prequalified). If not currently prequalified in the categories listed in Section A, an amendment to your Prequalification will need to be submitted prior to the same due date. Postmark is not applicable.

BIDS TO BE SUBMITTED: by hand to 1600 EMIL ST., MADISON, WI 53713 or online at [www.bidexpress.com](http://www.bidexpress.com).

THE BID OPENING is at 1600 EMIL ST., MADISON, WI 53713.

Bids may be submitted on line through Bid Express or in person at 1600 Emil St. The bids will be posted on line after the bid opening. If you have any questions, please call Alane Boutelle at (608) 267-1197, or John Fahrney at (608) 266-9091.

#### STANDARD SPECIFICATIONS

The City of Madison's Standard Specifications for Public Works Construction - 2021 Edition, as supplemented and amended from time to time, forms a part of these contract documents as if attached hereto.

These standard specifications are available on the City of Madison Public Works website, [www.cityofmadison.com/engineering/developers-contractors/standard-specifications](http://www.cityofmadison.com/engineering/developers-contractors/standard-specifications).

The Contractor shall review these Specifications prior to preparation of proposals for the work to be done under this contract, with specific attention to Article 102, "BIDDING REQUIREMENTS AND CONDITIONS" and Article 103, "AWARD AND EXECUTION OF THE CONTRACT." For the convenience of the bidder, below are highlights of three subsections of the specifications.

#### SECTION 102.1: PRE-QUALIFICATION OF BIDDERS

In accordance with Wisconsin State Statutes 66.0901 (2) and (3), all bidders must submit to the Board of Public Works proof of responsibility on forms furnished by the City. The City requires that all bidders be qualified on a biennial basis.

SECTION E: BIDDERS ACKNOWLEDGEMENT

THURBER LIFT STATION REPLACEMENT  
CONTRACT NO. 9063

Bidder must state a Unit Price and Total Bid for each item. The Total Bid for each item must be the product of quantity, by Unit Price. The Grand Total must be the sum of the Total Bids for the various items. In case of multiplication errors or addition errors, the Grand Total with corrected multiplication and/or addition shall determine the Grand Total bid for each contract. The Unit Price and Total Bid must be entered numerically in the spaces provided. All words and numbers shall be written in ink.

1. The undersigned having familiarized himself/herself with the Contract documents, including Advertisement for Bids, Instructions to Bidders, Form of Proposal, City of Madison Standard Specifications for Public Works Construction - 2021 Edition thereto, Form of Agreement, Form of Bond, and Addenda issued and attached to the plans and specifications on file in the office of the City Engineer, hereby proposes to provide and furnish all the labor, materials, tools, and expendable equipment necessary to perform and complete in a workmanlike manner the specified construction on this project for the City of Madison; all in accordance with the plans and specifications as prepared by the City Engineer, including Addenda Nos.   1   through   1   to the Contract, at the prices for said work as contained in this proposal. (Electronic bids submittals shall acknowledge addendum under Section E and shall not acknowledge here)
2. If awarded the Contract, we will initiate action within seven (7) days after notification or in accordance with the date specified in the contract to begin work and will proceed with diligence to bring the project to full completion within the number of work days allowed in the Contract or by the calendar date stated in the Contract.
3. The undersigned Bidder or Contractor certifies that he/she is not a party to any contract, combination in form of trust or otherwise, or conspiracy in restraint of trade or commerce or any other violation of the anti-trust laws of the State of Wisconsin or of the United States, with respect to this bid or contract or otherwise.
4. I hereby certify that I have met the Bid Bond Requirements as specified in Section 102.5. (IF BID BOND IS USED, IT SHALL BE SUBMITTED ON THE FORMS PROVIDED BY THE CITY. FAILURE TO DO SO MAY RESULT IN REJECTION OF THE BID).
5. I hereby certify that all statements herein are made on behalf of Speedway Sand & Gravel (name of corporation, partnership, or person submitting bid) a corporation organized and existing under the laws of the State of WI a partnership consisting of \_\_\_\_\_; an individual trading as \_\_\_\_\_; of the City of \_\_\_\_\_ State of \_\_\_\_\_; that I have examined and carefully prepared this Proposal, from the plans and specifications and have checked the same in detail before submitting this Proposal; that I have fully authority to make such statements and submit this Proposal in (its, their) behalf; and that the said statements are true and correct.

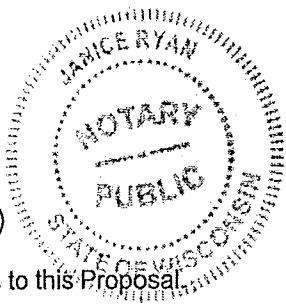
Dustin Bittner  
SIGNATURE

Vice President  
TITLE, IF ANY

Sworn and subscribed to before me this  
23 day of September, 2021.

Janice Ryan

(Notary Public or other officer authorized to administer oaths)  
My Commission Expires 10-21-21  
Bidders shall not add any conditions or qualifying statements to this Proposal.



Contract 9063 – Speedway Sand & Gravel, Inc.

Section F: Best Value Contracting (BVC)

This section is a required document for the bid to be considered complete. There are two methods for completing the Best Value Contracting (BVC) form. Method one: The form can be filled out online and submitted to this site to be included with your electronic bid. Method two: The form can be downloaded from the site and submitted by hand to the City of Madison.

Method of Submittal for BVC (click in box below to choose) \*

I will submit Bid Express fillable online form (BVC).

Best Value Contracting

1. The Contractor shall indicate the non-apprenticeable trades used on this contract.

2. Madison General Ordinance (M.G.O.), 33.07(7), does provide for some exemptions from the active apprentice requirement. Apprenticeable trades are those trades considered apprenticeable by the State of Wisconsin. Please check applicable box if you are seeking an exemption.

- Contractor has a total skilled workforce of four or less individuals in all apprenticeable trades combined.
- No available trade training program; The Contractor has been rejected by the only available trade training program, or there is no trade training program within 90 miles.
- Contractor is not using an apprentice due to having a journey worker on layoff status, provided the journey worker was employed by the contractor in the past six months.
- First time contractor on City of Madison Public Works contract requests a onetime exemption but intends to comply on all future contracts and is taking steps typical of a "good faith" effort.
- Contractor has been in business less than one year.
- Contractor doesn't have enough journeyman trade workers to qualify for a trade training program in that respective trade.
  
- An exemption is granted in accordance with a time period of a "Documented Depression" as defined by the State of Wisconsin.

3. The Contractor shall indicate on the following section which apprenticeable trades are to be used on this contract. Compliance with active apprenticeship, to the extent required by M.G.O. 33.07(7), shall be satisfied by documentation from an applicable trade training body; an apprenticeship contract with the Wisconsin Department of Workforce Development or a

similar agency in another state; or the U.S Department of Labor. This documentation is required prior to the Contractor beginning work on the project site.

- The Contractor has reviewed the list and shall not use any apprenticeable trades on this project.

LIST APPRENTICABLE TRADES (check all that apply to your work to be performed on this contract)

- BRICKLAYER
- CARPENTER
- CEMENT MASON / CONCRETE FINISHER
- CEMENT MASON (HEAVY HIGHWAY)
- CONSTRUCTION CRAFT LABORER
- DATA COMMUNICATION INSTALLER
- ELECTRICIAN
- ENVIRONMENTAL SYSTEMS TECHNICIAN / HVAC SERVICE TECH/HVAC INSTALL / SERVICE
- GLAZIER
- HEAVY EQUIPMENT OPERATOR / OPERATING ENGINEER
- INSULATION WORKER (HEAT and FROST)
- IRON WORKER
- IRON WORKER (ASSEMBLER, METAL BLDGS)
- PAINTER and DECORATOR
- PLASTERER
- PLUMBER
- RESIDENTIAL ELECTRICIAN
- ROOFER and WATER PROOFER
- SHEET METAL WORKER
- SPRINKLER FITTER
- STEAMFITTER
- STEAMFITTER (REFRIGERATION)
- STEAMFITTER (SERVICE)
- TAPER and FINISHER
- TELECOMMUNICATIONS (VOICE, DATA and VIDEO) INSTALLER-TECHNICIAN
- TILE SETTER

THURBER LIFT STATION REPLACEMENT  
CONTRACT NO. 9063

Small Business Enterprise Compliance Report

This information may be submitted electronically through  
Bid Express or submitted with bid in sealed envelope.

Cover Sheet

Prime Bidder Information

Company: Speedway Sand & Gravel

Address: 8500 Greenway Blvd Ste, 202 Middleton, WI 53562

Telephone Number: 608 836 1071 Fax Number: 608 836 7425

Contact Person/Title: Dustin Bittner

Prime Bidder Certification

I, Dustin Bittner, VP of  
Name Title

Speedway Sand & Gravel Company certify that the information

contained in this SBE Compliance Report is true and correct to the best of my knowledge and belief.

Janice Ryan  
Witness' Signature

Dustin Bittner  
Bidder's Signature

9/23/2021  
Date



**THURBER LIFT STATION REPLACEMENT**

CONTRACT NO. 9063

DATE: 9/23/2021

**Speedway Sand & Gravel,  
Inc.**

Item	Quantity	Price	Extension
<b>Section B: Proposal Page</b>			
10701 - TRAFFIC CONTROL - LUMP SUM	1.00	\$1,500.00	\$1,500.00
10790 - RAILROAD INSURANCE - LUMP SUM	1.00	\$2,500.00	\$2,500.00
10911 - MOBILIZATION - LUMP SUM	1.00	\$95,785.00	\$95,785.00
90070 - SANITARY SEWER LIFT STATION - LUMP SUM	1.00	\$860,739.00	\$860,739.00
90071 - CIPP SANITARY SEWER FORCE MAIN - 8 INCH - L.F.	126.00	\$215.32	\$27,130.32
<b>5 Items</b>	<b>Totals</b>		<b>\$987,654.32</b>





Department of Public Works  
**Engineering Division**  
Robert F. Phillips, P.E., City Engineer  
City-County Building, Room 115  
210 Martin Luther King, Jr. Boulevard  
Madison, Wisconsin 53703  
Phone: (608) 266-4751  
Fax: (608) 264-9275  
[engineering@cityofmadison.com](mailto:engineering@cityofmadison.com)  
[www.cityofmadison.com/engineering](http://www.cityofmadison.com/engineering)

**Deputy City Engineer**  
Gregory T. Fries, P.E.  
**Deputy Division Manager**  
Kathleen M. Cryan  
**Principal Engineer 2**  
Christopher J. Petykowski, P.E.  
John S. Fahrney, P.E.  
**Principal Engineer 1**  
Christina M. Bachmann, P.E.  
Mark D. Moder, P.E.  
Janet Schmldt, P.E.  
James M. Wolfe, P.E.  
**Facilities & Sustainability**  
Bryan Cooper, Principal Architect  
**Mapping Section Manager**  
Eric T. Pederson, P.S.  
**Financial Manager**  
Steven B. Danner-Rivers

## BIENNIAL BID BOND

Speedway Sand & Gravel, Inc.

(a corporation of the State of Wisconsin)  
(individual), (partnership), (hereinafter referred to as the "Principal") and  
Fidelity and Deposit Company of Maryland

a corporation of the State of Maryland (hereinafter referred to as the "Surety") and licensed to do business in the State of Wisconsin, are held and firmly bound unto the City of Madison, Wisconsin (hereinafter referred to as the "City"), in the sum equal to the individual proposal guaranty amounts of the total bid or bids of the Principal herein accepted by the City, for the payment of which the Principal and the Surety hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of this obligation is that the Principal has submitted to the City certain bids for projects from the time period of February 1, 2020 through January 31, 2022.

If the Principal is awarded the contract(s) by the City and, within the time and manner required by law after the prescribed forms are presented for its signature, the Principal enters into (a) written contract(s) in accordance with the bid(s), and files with the City its bond(s) guaranteeing faithful performance and payment for all labor and materials, as required by law, or if the City rejects all bids for the work described, then this obligation shall be null and void; otherwise, it shall remain in full force and effect.

In the event the Principal shall fail to execute and deliver the contract(s) or the performance and payment bond(s), all within the time specified or any extension thereof, the Principal and Surety agree jointly and severally to pay to the City within ten (10) calendar days of written demand a total equal to the sum of the individual proposal guaranty amounts of the total bid(s) as liquidated damages.

The Surety, for value received, hereby agrees that the obligations of it and its bond shall be in no way impaired or affected by any extension of time within which the City may accept a bid, and the Surety does hereby waive notice of any such extension.

This bond may be terminated by the Surety upon giving thirty (30) days written notice to the City of its intent to terminate this bond and to be released and discharged therefrom, but such termination shall not operate to relieve or discharge the Surety from any liability already accrued or which shall accrue before the expiration of such thirty (30) day period.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, on the day and year set forth below.

**PRINCIPAL**

Speedway Sand & Gravel, Inc.  
COMPANY NAME AFFIX SEAL

November 11, 2019  
DATE

By: *James Ryan*  
SIGNATURE AND TITLE Corp Sec.

**SURETY**

Fidelity and Deposit Company of Maryland  
COMPANY NAME AFFIX SEAL

November 11, 2019  
DATE

By: *Nicole Stillings*  
SIGNATURE AND TITLE  
Nicole Stillings, Attorney-in-Fact

This certifies that I have been duly licensed as an agent for the Surety in Wisconsin under National Provider No. 6966174 for the year 2020 and appointed as attorney in fact with authority to execute this bid bond, which power of attorney has not been revoked.

November 11, 2019  
DATE

*Nicole Stillings*  
AGENT SIGNATURE

1600 Aspen Commons, Suite 990  
ADDRESS

Middleton, WI 53562  
CITY, STATE AND ZIP CODE

608-242-2551  
TELEPHONE NUMBER

Note to Surety and Principal: Any bid submitted which this bond guarantees may be rejected if the Power of Attorney form showing that the Agent of Surety is currently authorized to execute bonds on behalf of Surety is not attached to this bond.

**ZURICH AMERICAN INSURANCE COMPANY  
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY  
FIDELITY AND DEPOSIT COMPANY OF MARYLAND  
POWER OF ATTORNEY**

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by Robert D. Murray, Vice President, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint Melinda C. BLODGETT, Colby D. WHITE, Jerome T. OUIOMET, Nicole STILLINGS, John E. TAUER, Joshua R. LOFTIS, Kurt C. LUNDBLAD, Ted JORGENSEN, R. C. BOWMAN, and Brian J. OESTREICH, all of Minneapolis, Minnesota, EACH, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: any and all bonds and undertakings, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND, this 26th day of June, A.D. 2019.



**ATTEST:**  
ZURICH AMERICAN INSURANCE COMPANY  
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY  
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Robert D. Murray  
Vice President

By: Dawn E. Brown  
Secretary

State of Maryland  
County of Baltimore

On this 26th day of June, A.D. 2019, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, Robert D. Murray, Vice President and Dawn E. Brown, Secretary of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, depose and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.



Constance A. Dunn, Notary Public  
My Commission Expires: July 9, 2023

**EXTRACT FROM BY-LAWS OF THE COMPANIES**

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify or revoke any such appointment or authority at any time."

**CERTIFICATE**

I, the undersigned, Secretary of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this 11th day of November, 2019.



*Brian M. Hodges*

By: Brian M. Hodges  
Vice President

**TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT A COMPLETE DESCRIPTION OF THE CLAIM INCLUDING THE PRINCIPAL ON THE BOND, THE BOND NUMBER, AND YOUR CONTACT INFORMATION TO:**

Zurich Surety Claims  
1299 Zurich Way  
Schaumburg, IL 60196-1056  
[www.reportsfclaims@zurichna.com](http://www.reportsfclaims@zurichna.com)  
800-626-4577

## CERTIFICATE OF BIENNIAL BID BOND

TIME PERIOD-VALID (FROM/TO) February 1, 2020 - January 31, 2022
NAME OF SURETY Fidelity and Deposit Company of Maryland
NAME OF CONTRACTOR Speedway Sand & Gravel, Inc.
CERTIFICATE HOLDER City of Madison, Wisconsin

This is to certify that a biennial bid bond issued by the above-named Surety is currently on file with the City of Madison.

This certificate is issued as a matter of information and conveys no rights upon the certificate holder and does not amend, extend or alter the coverage of the biennial bid bond.

Cancellation: Should the above policy be cancelled before the expiration date, the issuing Surety will give thirty (30) days written notice to the certificate holder indicated above.

  
\_\_\_\_\_  
SIGNATURE OF AUTHORIZED CONTRACTOR REPRESENTATIVE

12-10-19  
\_\_\_\_\_  
DATE

## SECTION H: AGREEMENT

THIS AGREEMENT made this 20<sup>th</sup> day of October in the year Two Thousand and Twenty-One between **SPEEDWAY SAND & GRAVEL, INC.** hereinafter called the Contractor, and the City of Madison, Wisconsin, hereinafter called the City.

WHEREAS, the Common Council of the said City of Madison under the provisions of a resolution adopted **OCTOBER 19, 2021**, and by virtue of authority vested in the said Council, has awarded to the Contractor the work of performing certain construction.

NOW, THEREFORE, the Contractor and the City, for the consideration hereinafter named, agree as follows:

1. **Scope of Work.** The Contractor shall, perform the construction, execution and completion of the following listed complete work or improvement in full compliance with the Plans, Specifications, Standard Specifications, Supplemental Specifications, Special Provisions and contract; perform all items of work covered or stipulated in the proposal; perform all altered or extra work; and shall furnish, unless otherwise provided in the contract, all materials, implements, machinery, equipment, tools, supplies, transportation, and labor necessary to the prosecution and completion of the work or improvements:

### THURBER LIFT STATION REPLACEMENT CONTRACT NO. 9063

2. **Completion Date/Contract Time.** Construction work must begin within seven (7) calendar days after the date appearing on mailed written notice to do so shall have been sent to the Contractor and shall be carried on at a rate so as to secure full completion SEE SPECIAL PROVISIONS, the rate of progress and the time of completion being essential conditions of this Agreement.
3. **Contract Price.** The City shall pay to the Contractor at the times, in the manner and on the conditions set forth in said specifications, the sum of **NINE HUNDRED EIGHTY-SEVEN THOUSAND SIX HUNDRED FIFTY-FOUR AND 32/100 (\$987,654.32)** Dollars being the amount bid by such Contractor and which was awarded to him/her as provided by law.
4. **Affirmative Action.** In the performance of the services under this Agreement the Contractor agrees not to discriminate against any employee or applicant because of race, religion, marital status, age, color, sex, disability, national origin or ancestry, income level or source of income, arrest record or conviction record, less than honorable discharge, physical appearance, sexual orientation, gender identity, political beliefs, or student status. The Contractor further agrees not to discriminate against any subcontractor or person who offers to subcontract on this contract because of race, religion, color, age, disability, sex, sexual orientation, gender identity or national origin.

The Contractor agrees that within thirty (30) days after the effective date of this agreement, the Contractor will provide to the City Affirmative Action Division certain workforce utilization statistics, using a form to be furnished by the City.

If the contract is still in effect, or if the City enters into a new agreement with the Contractor, within one year after the date on which the form was required to be provided, the Contractor will provide updated workforce information using a second form, also to be furnished by the City. The second form will be submitted to the City Affirmative Action Division no later than one year after the date on which the first form was required to be provided.

The Contractor further agrees that, for at least twelve (12) months after the effective date of this contract, it will notify the City Affirmative Action Division of each of its job openings at facilities in Dane County for which applicants not already employees of the Contractor are to be considered. The notice will include a job description, classification, qualifications and application procedures

and deadlines. The Contractor agrees to interview and consider candidates referred by the Affirmative Action Division if the candidate meets the minimum qualification standards established by the Contractor, and if the referral is timely. A referral is timely if it is received by the Contractor on or before the date started in the notice.

#### Articles of Agreement

##### Article I

The Contractor shall take affirmative action in accordance with the provisions of this contract to insure that applicants are employed, and that employees are treated during employment without regard to race, religion, color, age, marital status, disability, sex, sexual orientation, gender identity or national origin and that the employer shall provide harassment free work environment for the realization of the potential of each employee. Such action 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 insofar as it is within the control of the Contractor. The Contractor agrees to post in conspicuous places available to employees and applicants notices to be provided by the City setting out the provisions of the nondiscrimination clauses in this contract.

##### Article II

The Contractor shall in all solicitations or advertisements for employees placed by or on behalf of the Contractors state that all qualified or qualifiable applicants will be employed without regard to race, religion, color, age, marital status, disability, sex, sexual orientation, gender identity or national origin.

##### Article III

The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice to be provided by the City advising the labor union or worker's representative of the Contractor's equal employment opportunity and affirmative action commitments. Such notices shall be posted in conspicuous places available to employees and applicants for employment.

##### Article V

The Contractor agrees that it will comply with all provisions of the Affirmative Action Ordinance of the City of Madison, including the contract compliance requirements. The Contractor agrees to submit the model affirmative action plan for public works contractors in a form approved by the Affirmative Action Division Manager.

##### Article VI

The Contractor will maintain records as required by Section 39.02(9)(f) of the Madison General Ordinances and will provide the City Affirmative Action Division with access to such records and to persons who have relevant and necessary information, as provided in Section 39.02(9)(f). The City agrees to keep all such records confidential, except to the extent that public inspection is required by law.

##### Article VII

In the event of the Contractor's or subcontractor's failure to comply with the Equal Employment Opportunity and Affirmative Action Provisions of this contract or Section 39.03 and 39.02 of the Madison General Ordinances, it is agreed that the City at its option may do any or all of the following:

1. Cancel, terminate or suspend this Contract in whole or in part.

2. Declare the Contractor ineligible for further City contracts until the Affirmative Action requirements are met.
3. Recover on behalf of the City from the prime Contractor 0.5 percent of the contract award price for each week that such party fails or refuses to comply, in the nature of liquidated damages, but not to exceed a total of five percent (5%) of the contract price, or ten thousand dollars (\$10,000), whichever is less. Under public works contracts, if a subcontractor is in noncompliance, the City may recover liquidated damages from the prime Contractor in the manner described above. The preceding sentence shall not be construed to prohibit a prime Contractor from recovering the amount of such damage from the non-complying subcontractor.

#### Article VIII

The Contractor shall include the above provisions of this contract in every subcontract so that such provisions will be binding upon each subcontractor. The Contractor shall take such action with respect to any subcontractor as necessary to enforce such provisions, including sanctions provided for noncompliance.

#### Article IX

The Contractor shall allow the maximum feasible opportunity to small business enterprises to compete for any subcontracts entered into pursuant to this contract. (In federally funded contracts the terms "DBE, MBE and WBE" shall be substituted for the term "small business" in this Article.)

5. Substance Abuse Prevention Program Required. Prior to commencing work on the Contract, the Contractor, and any Subcontractor, shall have in place a written program for the prevention of substance abuse among its employees as required under Wis. Stat. Sec. 103.503.
6. **Contractor Hiring Practices.**

#### **Ban the Box - Arrest and Criminal Background Checks. (Sec. 39.08, MGO)**

This provision applies to all prime contractors on contracts entered into on or after January 1, 2016, and all subcontractors who are required to meet prequalification requirements under MGO 33.07(7)(I), MGO as of the first time they seek or renew pre-qualification status on or after January 1, 2016. The City will monitor compliance of subcontractors through the pre-qualification process.

- a. **Definitions.** For purposes of this section, "Arrest and Conviction Record" includes, but is not limited to, information indicating that a person has been questioned, apprehended, taken into custody or detention, held for investigation, arrested, charged with, indicted or tried for any felony, misdemeanor or other offense pursuant to any law enforcement or military authority.

"Conviction record" includes, but is not limited to, information indicating that a person has been convicted of a felony, misdemeanor or other offense, placed on probation, fined, imprisoned or paroled pursuant to any law enforcement or military authority.

"Background Check" means the process of checking an applicant's arrest and conviction record, through any means.

- b. **Requirements.** For the duration of this Contract, the Contractor shall:
  1. Remove from all job application forms any questions, check boxes, or other inquiries regarding an applicant's arrest and conviction record, as defined herein.



2. Refrain from asking an applicant in any manner about their arrest or conviction record until after conditional offer of employment is made to the applicant in question.
3. Refrain from conducting a formal or informal background check or making any other inquiry using any privately or publicly available means of obtaining the arrest or conviction record of an applicant until after a conditional offer of employment is made to the applicant in question.
4. Make information about this ordinance available to applicants and existing employees, and post notices in prominent locations at the workplace with information about the ordinance and complaint procedure using language provided by the City.
5. Comply with all other provisions of Sec. 39.08, MGO.

**c. Exemptions:** This section shall not apply when:

1. Hiring for a position where certain convictions or violations are a bar to employment in that position under applicable law, or
2. Hiring a position for which information about criminal or arrest record, or a background check is required by law to be performed at a time or in a manner that would otherwise be prohibited by this ordinance, including a licensed trade or profession where the licensing authority explicitly authorizes or requires the inquiry in question.

To be exempt, Contractor has the burden of demonstrating that there is an applicable law or regulation that requires the hiring practice in question, if so, the contractor is exempt from all of the requirements of this ordinance for the position(s) in question.

**SECTION I: PAYMENT AND PERFORMANCE BOND**

LET ALL KNOW BY THESE DOCUMENTS PRESENTED, that we **SPEEDWAY SAND & GRAVEL, INC.** as principal, and **Fidelity and Deposit Company of Maryland** Company of **Schaumburg, IL** as surety, are held and firmly bound unto the City of Madison, Wisconsin, in the sum of **NINE HUNDRED EIGHTY-SEVEN THOUSAND SIX HUNDRED FIFTY-FOUR AND 32/100 (\$987,654.32)** Dollars, lawful money of the United States, for the payment of which sum to the City of Madison, we hereby bind ourselves and our respective executors and administrators firmly by these presents.

The condition of this Bond is such that if the above bounden shall on his/her part fully and faithfully perform all of the terms of the Contract entered into between him/herself and the City of Madison for the construction of:

**THURBER LIFT STATION REPLACEMENT  
CONTRACT NO. 9063**

in Madison, Wisconsin, and shall pay all claims for labor performed and material furnished in the prosecution of said work, and save the City harmless from all claims for damages because of negligence in the prosecution of said work, and shall save harmless the said City from all claims for compensation (under Chapter 102, Wisconsin Statutes) of employees and employees of subcontractor, then this Bond is to be void, otherwise of full force, virtue and effect.

Signed and sealed this 20th day of October, 2021

Countersigned:

**SPEEDWAY SAND & GRAVEL, INC.**

Company Name (Principal)

[Signature]  
Witness

[Signature]  
V. President Seal **NA**

[Signature]  
Secretary

Approved as to form:

**Fidelity and Deposit Company of Maryland**

Surety Seal

Salary Employee  Commission

[Signature]  
City Attorney

By [Signature]  
Attorney-in-Fact **Nicole Stillings**

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under National Producer Number **6966174** for the year **2021**, and appointed as attorney-in-fact with authority to execute this payment and performance bond which power of attorney has not been revoked.

October 20, 2021  
Date

[Signature]  
Agent Signature

**THURBER LIFT STATION REPLACEMENT  
CONTRACT NO. 9063**


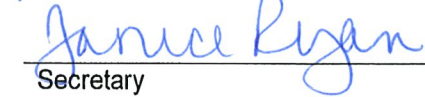
IN WITNESS WHEREOF, the Contractor has hereunto set his/her hand and seal and the City has caused this contract to be sealed with its corporate seal and to be executed by its Mayor and City Clerk on the dates written below.

Countersigned:

	10/20/2021
Witness	Date
	10/20/2021
Witness	Date


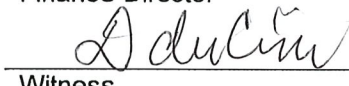
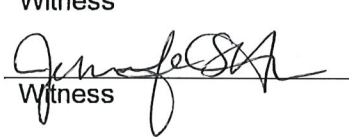
**SPEEDWAY SAND & GRAVEL, INC.**

Company Name

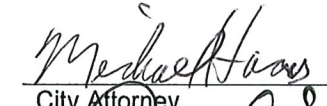
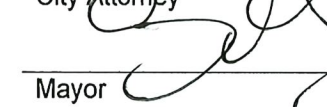

	10/20/2021
President	Date
	10/20/2021
Secretary	Date

CITY OF MADISON, WISCONSIN

Provisions have been made to pay the liability that will accrue under this contract.

	11/15/2021
Finance Director	Date
	11.17.21
Witness	Date
	10-27-21
Witness	Date

Approved as to form:

	11-17-21
City Attorney	Date
	11/17/21
Mayor	Date
	10-27-2021
City Clerk	Date

**ZURICH AMERICAN INSURANCE COMPANY  
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY  
FIDELITY AND DEPOSIT COMPANY OF MARYLAND  
POWER OF ATTORNEY**

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by **Robert D. Murray, Vice President**, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **Melinda C. BLODGETT, Colby D. WHITE, Jerome T. OUIOMET, Nicole STILLINGS, Joshua R. LOFTIS, Ted JORGENSEN, R. C. BOWMAN, Brian J. OESTREICH and Nathan WEAVER, all of Minneapolis, Minnesota**, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings**, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND, this 9th day of June, A.D. 2021.



**ATTEST:**  
ZURICH AMERICAN INSURANCE COMPANY  
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY  
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: *Robert D. Murray*  
Vice President

By: *Dawn E. Brown*  
Secretary

**State of Maryland  
County of Baltimore**

On this 9th day of June, A.D. 2021, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, depose and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.



Constance A. Dunn, Notary Public  
My Commission Expires: July 9, 2023

**EXTRACT FROM BY-LAWS OF THE COMPANIES**

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify or revoke any such appointment or authority at any time."

**CERTIFICATE**

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this 20th day of October, 2021.



By: Brian M. Hodges  
Vice President

**TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT A COMPLETE DESCRIPTION OF THE CLAIM INCLUDING THE PRINCIPAL ON THE BOND, THE BOND NUMBER, AND YOUR CONTACT INFORMATION TO:**

Zurich Surety Claims  
1299 Zurich Way  
Schaumburg, IL 60196-1056  
[www.reportsfclaims@zurichna.com](http://www.reportsfclaims@zurichna.com)  
800-626-4577

Authenticity of this bond can be confirmed at [bondvalidator.zurichna.com](http://bondvalidator.zurichna.com) or 410-559-8790