

NAME OF BIDDER: \_\_\_\_\_

BID OF \_\_\_\_\_

**PROPOSAL, CONTRACT, BOND AND SPECIFICATIONS**

**FOR**

**WELL 15 VOC AIR STRIPPER**

**CONTRACT NO. 6941**

**IN**

**MADISON, DANE COUNTY, WISCONSIN**

AWARDED BY THE COMMON COUNCIL  
MADISON, WISCONSIN ON \_\_\_\_\_

**PLEASE RETURN PLANS AND SPECIFICATIONS TO:**

**CITY ENGINEERING DIVISION  
1600 EMIL STREET  
MADISON, WISCONSIN 53713**

[www.cityofmadison.com/business/pw](http://www.cityofmadison.com/business/pw)

**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

**INDEX**

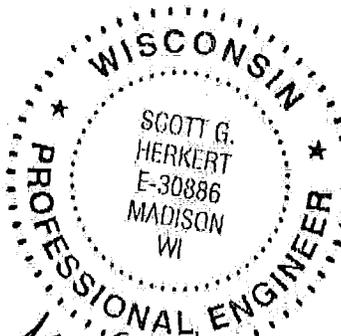
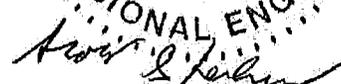
SECTION A: ADVERTISEMENT FOR BIDS .....A-1  
SECTION B: INSTRUCTIONS TO BIDDERS .....B-1  
SECTION C: SBE .....C-1  
SECTION D: SPECIAL PROVISIONS .....D-1  
SECTION E: PROPOSAL .....E-1  
SECTION F: BID BOND .....F-1  
SECTION G: AGREEMENT .....G-1  
SECTION H: PAYMENT AND PERFORMANCE BOND .....H-1  
SECTION I: PREVAILING WAGE RATE .....I-1

This Proposal, and Agreement have  
been prepared by:

**MADISON WATER UTILITY  
MADISON, DANE COUNTY, WISCONSIN**

 8/9/12  
Alan L. Larson, Principal Engineer

  
  
8/8/2012

  
  
8/8/2012

## SECTION A: ADVERTISEMENT FOR BIDS

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

#### A BEST VALUE CONTRACTING MUNICIPALITY

<b>CONTRACT NO.</b>	<b>PROJECT NAME:</b>
6941	WELL 15 VOC AIR STRIPPER
SBE GOAL	6%

**Plans and Specifications** are available at 1600 Emil Street, Madison, WI 53713; 608-267-1197 or on our website at [www.cityofmadison.com/business/pw/contracts/openforBid.cfm](http://www.cityofmadison.com/business/pw/contracts/openforBid.cfm).

#### PREQUALIFICATIONS

Bidders who have not been prequalified by the City Engineer and Affirmative Action Director for the period of **February 1, 2012 to January 31, 2013** must submit their application on or before 1 P.M., September 7, 2012, Room 115, City-County Building, Madison, WI 53703. Postmark is not applicable. Contractors shall be prequalified by the City Engineer including an affirmative action plan approved by the Affirmative Action Director prior to the bid opening or the bid will be rejected. Forms are available at the same location or on our website at [www.cityofmadison.com/business/pw/forms.cfm](http://www.cityofmadison.com/business/pw/forms.cfm).

#### PRE-BID MEETING

Representatives of the Affirmative Action Department will be present to discuss the Small Business Enterprise requirements on August 22, 2012 at 1:30 P.M. at 119 E. Olin Avenue, Madison, WI 53713. Immediately following the Affirmative Action Department's presentation, the existing Well 15 facility will be open for bidders. The site address is 3900 E. Washington Avenue, Madison, WI 53704.

#### OTHER REQUIREMENTS

Sealed bids must be accompanied with a Bid Bond equal to at least 5% of the bid or a Certificate of Annual/Biennial Bid Bond or certified check, payable to the City Treasurer.

Prevailing Wage Rates may be required and are attached in Section I of the contract. See Special Provisions to determine applicability.

Deadline for the Submittal of Bid is September 7, 2012 by 1 P.M., at 1600 Emil Street, Madison, WI 53713.

Bid Opening will be on September 14, 2012 at 1:30 PM at 1600 Emil Street, Madison, WI 53713.

#### REQUEST FOR BIDS FOR PUBLIC WORKS CONSTRUCTION FOR THE CITY OF MADISON, WISCONSIN

#### A BEST VALUE CONTRACTING MUNICIPALITY

Plans and Specifications for Public Works Projects that are open for bid are available on the City of Madison website at <http://www.cityofmadison.com/business/PW/contracts/openforBid.cfm> or by calling City Engineering at 608-266-4751.

Sealed bids must be accompanied with a Bid Bond equal to at least 5% of the bid or a Certificate of Annual/Biennial Bid Bond or certified check, payable to the City Treasurer.

Prevailing Wage Rates may be required and are attached in Section I of the contract. See Special Provisions to determine applicability.

Bidders must be prequalified with the City Engineer and the Affirmative Action Director. Deadline date for submittal of application is noticed on our website. Forms are available on the web at <http://www.cityofmadison.com/business/pw/forms.cfm> or by contacting City Engineering at 608-266-4620

Publ. WSJ

## SECTION B: INSTRUCTIONS TO BIDDERS

The City of Madison Standard Specifications for Public Works Construction - 2012 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 at [www.cityofmadison.com/Business/PW/specs.cfm](http://www.cityofmadison.com/Business/PW/specs.cfm) or by contacting City Engineering Division, Room 115, City-County Building, 210 Martin Luther King Jr. Blvd., Madison, WI 53703.

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 Madison 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 Madison General Ordinances (entitled Affirmative Action) and as required by Section 102.11 of the Standard Specifications.

### Section 102.4: Proposals

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 therefore 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. Proposals will be received at the place and until the hour on the date designated in the advertisement. When sent by mail, the sealed proposal marked as indicated above shall be enclosed in an additional envelope. Proposals sent by mail, submitted in person or otherwise delivered must be in the hands of the official conducting the letting by the hour on the date designated in the advertisement. Proposals received after the date designated will be returned to the bidder unopened.

**The Bidder shall execute form ERD-7777 (R.9/03), a part of these proposal pages and submit same with the bidder's proposal, if applicable. REFER TO PROPOSAL SECTION.**

For cash allowances the Contract Price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances. These costs shall not be included in the cash allowance. The final Contract Price will be adjusted to reflect actual costs on account of cash allowances.

The following cash allowances shall be included in the Bid for the Contract(s).

Underground Electrical Service	Section 16420–Electrical Service System
SCADA Software Improvements at Master Station	Section 16940–Controls and Instrumentation
Card Access System	Section 16940–Controls and Instrumentation
Video Surveillance System	Section 16940–Controls and Instrumentation

Section 102.5: Bid Deposit (Proposal Guaranty)

No proposal shall be considered unless either (i) it is accompanied by a bid deposit of the character and amount described in the Advertisement for Bids or (ii) a biennial bid bond in an amount and form acceptable to the City of Madison has been previously submitted.

Bid deposits of unsuccessful bidders shall be returned following the award of the contract by the Common Council. Bid deposit of the successful bidders shall be returned within forty-eight (48) hours following execution of the contract and bond as required.

**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 type="checkbox"/> Sanitary, Storm Sewer & Water Main Const.      |
| 215 <input type="checkbox"/> Concrete Paving  | 280 <input type="checkbox"/> Sewer Lateral Drain Cleaning/Internal TV Insp. |
| 220 <input type="checkbox"/> Con. Sidewalk/Curb & Gutter/Misc. Concrete Work                | 285 <input type="checkbox"/> Sewer Lining                                   |
| 221 <input type="checkbox"/> Concrete Bases and Other Concrete Work                         | 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                            |
| 242 <input type="checkbox"/> Infrared Seamless Patching                                     | 315 <input type="checkbox"/> Street Lighting                                |
| 245 <input type="checkbox"/> Landscaping, Maintenance                                       | 318 <input type="checkbox"/> Tennis Court Resurfacing                       |
| 250 <input type="checkbox"/> Landscaping, Site and Street                                   | 330 <input type="checkbox"/> Traffic Control During Construction            |
| 251 <input type="checkbox"/> Parking Ramp Maintenance                                       | 320 <input type="checkbox"/> Traffic Signals                                |
| 255 <input type="checkbox"/> Pavement Sealcoating and Crack Sealing                         | 325 <input type="checkbox"/> Traffic Signing & Marking                      |
| 260 <input type="checkbox"/> Petroleum Above/Below Ground Storage Tank Removal/Installation | 335 <input type="checkbox"/> Trucking                                       |
|   | 399 <input type="checkbox"/> Other _____                                    |

**Bridge Construction**

- 501  Bridge Construction and/or Repair

**Building Construction**

- |  |   |
|--|---|
| 401 <input type="checkbox"/> Floor Covering (including carpet, ceramic tile installation, rubber, VCT) | 435 <input type="checkbox"/> Masonry  |
| 402 <input type="checkbox"/> Building Automation Systems   | 437 <input type="checkbox"/> Metals   |
| 403 <input type="checkbox"/> Concrete  | 440 <input type="checkbox"/> Painting and Wallcovering                              |
| 404 <input type="checkbox"/> Doors and Windows   | 445 <input type="checkbox"/> Plumbing   |
| 405 <input type="checkbox"/> Electrical - Power, Lighting & Communications                             | 450 <input type="checkbox"/> Pump Repair  |
| 410 <input type="checkbox"/> Elevator - Lifts  | 455 <input type="checkbox"/> Pump Systems   |
| 412 <input type="checkbox"/> Fire Suppression  | 460 <input type="checkbox"/> Roofing and Moisture Protection                        |
| 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 type="checkbox"/> General Building Construction, \$250,000 to \$1,500,000                   | 466 <input type="checkbox"/> Warning Sirens   |
| 425 <input checked="" 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  |   |

**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: <http://www.dhs.wisconsin.gov/Asbestos/Cert/Index.htm>. State of Wisconsin Performance of Asbestos Abatement Certificate must be attached.
- 6     Other \_\_\_\_\_

**SECTION C: SBE**  
**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/dcr/aaTBDir.cfm](http://www.cityofmadison.com/dcr/aaTBDir.cfm).

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/dcr/aaTBDir.cfm](http://www.cityofmadison.com/dcr/aaTBDir.cfm). 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.

## 2.4.2 Reporting SBE Utilization and Good Faith Efforts

The Small Business Enterprise Compliance Report is to be submitted by the bidder in a separate sealed envelope marked: **“ENVELOPE 2 - SBE COMPLIANCE REPORT.”** This report is due by the specified bid closing time and date. Bids submitted without a completed SBE Compliance Report as outlined below shall be deemed non-responsible and the bidder ineligible for award of this contract.

- 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-7; and
- 2.4.2.1.2 **Summary Sheet**, C-8.

- 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-7;
- 2.4.2.2.2 **Summary Sheet**, C-8; and
- 2.4.2.2.3 **SBE Contact Report**, C-9 and C-10. (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 deemed non-responsible for failure to demonstrate a good faith effort to achieve such goal and subsequently denied eligibility for award of contract may, within 72 hours of receiving such notification, appeal that decision to a special appeals committee composed of three (3) members of the Affirmative Action Commission, three (3) members of the Board of Public Works and a seventh member appointed by the Mayor. All appeals must be made in writing to the City Engineer and received within 72 hours of City of Madison’s notice. Postmark not applicable.

## 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 with annual gross receipts of less than \$750,000 when averaged over the past three year period;

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.





**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

**Small Business Enterprise Compliance Report**

**SBE Contact Report**

**This information MUST be submitted in a separate sealed envelope marked  
“ENVELOPE NO. 2 - SBE COMPLIANCE REPORT.”**

Submit separate copy of this form for each SBE which you are not able to utilize towards meeting the SBE goal for this project. Attach separate sheets if necessary.

**SBE Information:**

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

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

Telephone Number: \_\_\_\_\_

Contact Person/Title: \_\_\_\_\_

1. Outline below all efforts to solicit a bid from the above SBE. Include date, means of contact, who from your company made this contact and the result.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Describe the information provided to the aforementioned SBE regarding the scope of work for which he/she was to provide a bid.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Is this the same scope of work on which the subcontractor you intend to utilize based his/her bid?

Yes     No

3. Did this SBE submit a bid?     Yes     No

4. Is the General Contractor pre-qualified to self-perform this category of work?

Yes     No

5. If you responded "Yes" to Question 3, please check the items below which apply and provide the requested detail. If you responded "No" to Question 3, please skip ahead to item 6 below.

The SBE listed above is unavailable for work on this project for the following reasons. Provide specific detail for this conclusion.

---

---

The SBE listed above is unqualified for work on this project. Provide specific details for this conclusion.

---

---

The SBE listed above provided a price that was unreasonable (i.e. more than 5% above the lowest bidder). Provide specific detail for this conclusion including the SBE's price and the price of the subcontractor you intend to utilize.

---

---

A contract with the SBE listed above may constitute a breach of the bidder's collective bargaining agreements. Provide specific detail for this conclusion including, but not limited to, correspondence from the SBE indicating it will not sign a project labor agreement and/or correspondence from the applicable trade union indicating a project labor agreement will not be allowed at the time of project bidding.

---

---

Other; please specify reason(s) other than listed above which made it impossible for you to utilize this SBE on this project.

---

---

6. Describe any other good faith efforts:

---

---

## SECTION D: SPECIAL PROVISIONS

### WELL 15 VOC AIR STRIPPER CONTRACT NO. 6941

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.

#### **SECTION 101: DEFINITIONS AND TERMS**

**Relationship Between the City and Strand Associates, Inc.**® Strand Associates, Inc.® has been engaged by the City to prepare drawings and specifications for this project. Additionally, Strand will assist the City with resident engineering and shop drawing review during construction. The City will provide 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.

**Relationship Between the City and Strand Associates, Inc.**® The duties and responsibilities of the resident project representative include the following:

1. Review schedules as required.
2. Attend conferences and meetings with CONTRACTOR.
3. Serve as liaison between ENGINEER and CONTRACTOR and help ENGINEER serve as liaison between OWNER and CONTRACTOR.
4. Conduct on-site observation of the work.
5. Observe tests, equipment, and system startups.
6. Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed. Consider, evaluate, and report to ENGINEER, CONTRACTOR's requests for modification.
7. Maintain orderly records, keep a daily log (when on a part-time basis, keep log for days visiting site), and furnish periodic reports to ENGINEER of the progress of the Work.
8. Before project completion, prepare final list of items to be completed or corrected and make recommendations to ENGINEER concerning acceptance of the Work.

The resident project representatives shall not:

1. Authorize any deviation from the Contract Documents or substitutions of materials or equipment.
2. Exceed limitations of ENGINEER'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 CONTRACTOR.
7. Authorize OWNER 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 ENGINEER.

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

**SPECIAL PROVISIONS** include Divisions 1 through 16 bound at the end of this document.

**ARTICLE 102.3      EQUAL BENEFITS REQUIREMENT (SEC. 39.07, MGO)**

This provision applies to contracts executed by the City on July 1, 2012 or later, unless exempt by Sec. 39.07 of the Madison General Ordinances (MGO).

For the duration of this Contract, the Contractor agrees to offer and provide benefits to employees with domestic partners that are equal to the benefits offered and provided to married employees with spouses, and to comply with all provisions of Sec. 39.07, MGO. If a benefit would be available to the spouse of a married employee, or to the employee based on his or her status as a spouse, the benefit shall also be made available to a domestic partner of an employee, or to the employee based on his or her status as a domestic partner. "Benefits" include any plan, program or policy provided or offered to employees as part of the employer's total compensation package, including but not limited to, bereavement leave, family medical leave, sick leave, health insurance or other health benefits, dental insurance or other dental benefits, disability insurance, life insurance, membership or membership discounts, moving expenses, pension and retirement benefits, and travel benefits.

Cash Equivalent. If after making a reasonable effort to provide an equal benefit for a domestic partner of an employee, the Contractor is unable to provide the benefit, the Contractor shall provide the employee with the cash equivalent of the benefit.

Proof of Domestic Partner Status. The Contractor may require an employee to provide proof of domestic partnership status as a prerequisite to providing the equal benefits. Any such requirement of proof shall comply with Sec. 39.07(4), MGO.

Notice Posting, Compliance. The Contractor shall post a notice informing all employees of the equal benefit requirements of this Contract, the complaint procedure, and agrees to produce records upon request of the City, as required by Sec. 39.07, MGO.

Subcontractors. Contractor shall require all subcontractors, the value of whose work exceeds the single-trade minimum set forth in Sec 33.07(7)(b)5., MGO, to provide equal benefits in compliance with Sec. 39.07, MGO.

See Section 39.07 MGO for exemptions from this requirement. Exemptions from this requirement include a Contractor whose employees are under a collective bargaining agreement that was in effect prior to July 1, 2012, however, the Contractor must agree to propose to the applicable collective bargaining unit(s) that an equal benefit requirement consistent with this ordinance be incorporated into the next collective bargaining agreement or in the existing agreement upon amendment, extension or other modification that occurs after July 1, 2012.

**SECTION 102.4:     PROPOSAL**

ADD the following to the end of Section 102.4:

For cash allowances the Contract Price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances. These costs shall not be included in the cash allowance. The final Contract Price will be adjusted to reflect actual costs on account of cash allowances.

The following cash allowances shall be included in the Bid for the Contract(s).

Underground Electrical Service	Section 16420–Electrical Service System
SCADA Software Improvements at Master Station	Section 16940–Controls and Instrumentation
Card Access System	Section 16940–Controls and Instrumentation
Video Surveillance System	Section 16940–Controls and Instrumentation

**SECTION 102.9:     BIDDER’S UNDERSTANDING**

Section 102.9 is amended as follows:

In the preparation of Drawings and Specifications, Strand Associates, Inc.<sup>®</sup> relied upon the following reports of explorations and tests of subsurface conditions at the Site which are attached at the end of the **SPECIAL PROVISIONS: GEOTECHNICAL EXPLORATION REPORT, WELL 15 VOC FACILITY, dated April 25, 2012 by CGC, Inc.**

The technical data in the above report(s), upon which CONTRACTOR may rely, consists of boring methods, level of subsurface water, boring logs, laboratory test methods and results, and boring locations all as of the date made.

ENGINEER accepts no responsibility for accuracy of the soil data or water level information. Soil borings and report, included with these Contract Documents, were not obtained for the purposes of designing excavations and trenches. Soils information was used by Strand Associates, Inc.<sup>®</sup> for analysis purposes of existing bridge abutments only. CONTRACTOR shall assure itself by personal examination as to subsurface conditions and shall provide its own investigations and make its own assumptions to

comply with OSHA and any other applicable laws and regulations regarding excavation and trenching requirements.

The following drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) are known to OWNER:

1. Drawings dated 1965, prepared by Black & Veatch Consulting Engineers of Kansas City, Missouri, titled: Plans for Water Works Improvements Madison Wisconsin Sunnyside Unit Well Station, consisting of 9 sheets numbered 1 to 8, inclusive, and one unnumbered title sheet.

None of the contents of such drawings include technical data on which CONTRACTOR may rely.

The drawings identified above are not part of the Contract Documents, but the “technical data” contained therein upon which CONTRACTOR may rely, as expressly identified and established above, are incorporated into the Contract Documents by reference. CONTRACTOR is not entitled to rely upon any other information and data known to or identified by OWNER or ENGINEER.

Copies of reports and drawings identified that are not included with the Bidding Documents may be examined at Strand Associates, Inc.<sup>®</sup>, 910 West Wingra Drive, Madison, WI 53715 during regular business hours.

#### **SECTION 102.10: MINIMUM RATE OF WAGE SCALE**

For this project, payment of prevailing wages (white sheet) is not required if either: a single trade accounts for 85% or more of the total labor costs of the project and the bid is less than \$48,000; or no single trade accounts for 85% or more of the total labor costs of the project and the bid is less than \$100,000. For bids not meeting either of these conditions, prevailing wages shall be required.

If required, the wages and benefits paid on the contract shall not be less than those specified in the Prevailing Wage Determination included with these contract documents for the following types of work:

- Building and Heavy Construction
- Sewer, Water, and Tunnel Construction
- Local Street and Miscellaneous Paving Operations
- Residential and Agricultural Construction

All bidders are notified that all labor employed on City contracts must be paid in accordance with the minimum rate of wage scale included in the Contract Documents.

For the information of the employees working on the project, a copy of the wage scale included in the contract documents and the provisions of Section 66.0903(8) of the Wisconsin Statutes shall be kept posted by the employer and in at least one conspicuous and easily accessible place at the site of the project.

The Contractor shall keep weekly payroll records setting forth the name, address, telephone number, classification, wage rate and fringe benefit package of each employee who worked on such City project and all other projects the employee worked in the same period, and the Contractor must keep records of the individual time each employee worked on the project and for each day of the project. Such records shall also set forth the total number of hours of overtime credited to each such employee for each day and week and the amount of overtime pay received in that week. Such records shall, in addition, set forth the full weekly wages earned by each such employee and the actual hourly wage paid to that employee. The Contractor shall submit payroll records to the Engineer every week for those periods when work is being done on the project. Said submittal shall be within twenty-one (21) calendar days of the end of the Contractor’s weekly pay period.

The Contractor shall ensure that employees shall be paid unconditionally and shall receive the full amounts accrued at the time of payment, computed at rates not less than those stated in the City of Madison "Minimum Rate of Wage Scale" and that each employee's rate shall be determined by the work that is done within the trade or occupation classification which should be properly assigned to such employee. Questions regarding an employee's classification or rate of pay within that classification, shall be resolved by the practice that predominates in the industry and on which the trade or occupation rate/classification is based. Therefore, rate of pay, classification and work jurisdiction disputes shall be resolved by relying upon practices established by collective bargaining agreements and guidelines used in such determinations by appropriate recognized trade unions operating within the City of Madison.

The Contractor shall agree that the normal rate of wage paid to the Contractor's employees on other projects shall not be reduced or otherwise diminished as a result of the requirement to pay no less than the minimum rate of wage scale on a City project. Mulcting of employees on City projects by contractors, such as by kickbacks or other such devices, is prohibited.

These contract provisions shall apply to all work performed on the contract by the Contractor with its own organization and with assistance of laborers under its immediate superintendency and to all work performed by piecework or by subcontract. No laborer, worker, or mechanic shall be employed directly upon the site of the work except on a wage basis, but this shall not be construed to prohibit the rental of equipment from individuals.

In the event of a refusal by the Contractor to submit payroll records as required by the contract, the City of Madison shall have the option to cancel this contract and request the Surety to perform or to relet the balance of the work for bids, and in that event, to charge the Contractor for any loss which the City may incur thereby.

#### **SECTION 102.12: BEST VALUE CONTRACTING**

This Contract shall be considered a Best Value Contract if the Contractor's bid is equal to or greater than \$51,500 for a single trade contract; or equal to or greater than \$251,000 for a multi-trade contract pursuant to MGO 33.07(7).

#### **SECTION 105.1: AUTHORITY OF THE ENGINEER**

The Engineer shall resolve all questions which arise as to the quality and acceptability of materials furnished, work performed, manner of performance, rate of progress of the work, interpretation of the plans and Specifications, acceptable fulfillment of the contract, compensation, and disputes and mutual rights between Contractors under the Specifications. The Engineer shall determine the amount and quantity of work performed and materials furnished.

All decisions of the Engineer shall, when so requested, be rendered in writing. They shall be final and conclusive in all matters unless within ten (10) days after such decision the Contractor applies in writing to the Board of Public Works for a review of such decision.

Any change proposed by a Contractor in SBE subcontractors, vendors or suppliers from those SBEs indicated on the SBE Compliance Report must be approved by the Engineer and the City's Manager of the Affirmative Action Division (hereafter, AAD). When requested, such decision shall be rendered in writing. Such decisions shall be final and conclusive in all matters unless within ten (10) days after such decision the Contractor or the affected SBE applies in writing to the Board of Public Works for a review of such decision.

In the event the Engineer and the AAD disagree over the proper decision to be made regarding an SBE, the Mayor shall appoint a third person to resolve the disagreement, within 30 days of appointment. The decision thus rendered may be reviewed by the Board of Public Works upon request of the Contractor or the affected SBE as set forth in Sections 105.1 and 105.2 of the City's standard specifications.

**SECTION 105.6: CONTRACTOR'S RESPONSIBILITY FOR WORK**

Add the following paragraph to the end of Section 105.6:

CONTRACTOR shall keep at the Site at all times during the progress of the Work a competent person to comply with OSHA trenching and excavation requirements. The competent person shall be one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

CONTRACTOR shall provide a photographic record of construction and construction progress. Provide a minimum of 10 photos per week. All utilities that are buried or hidden within the construction shall be photographed prior to covering. CONTRACTOR shall submit photographs in the format described below with each payment application.

Photographs shall be color digital photographs. Photographs shall be date-stamped. Photographs shall be provided in a digital format only on compact disc media. Photographs shall be submitted in the .jpg format. Alternate formats may be approved by the OWNER. Photos shall be taken with a minimum 3.5 megapixel camera at highest quality resolution.

CONTRACTOR shall provide a photo log in a Word document stored on compact disk. The photo log shall include photo identification, file name, location information, brief description, and date of photo. Photo log shall contain a minimum of five photographs per week.

CONTRACTOR shall provide and maintain an e-mail address for electronic communication.

**SECTION 105.7: CONTRACT DRAWINGS**

Add the following paragraph to the end of Section 105.7:

CONTRACTOR shall keep one record copy of all specifications, drawings, addenda, modifications, and shop drawings at the site in good order and shall record on the drawings all changes made during the construction process. CONTRACTOR providing buried or concealed piping, conduit, or similar items shall locate all such items by dimensions and elevations. The daily record of changes shall be the responsibility of CONTRACTOR's field superintendent. No arbitrary mark-ups shall be permitted. CONTRACTOR shall submit his marked up record documents to ENGINEER **prior** to final payment. CONTRACTOR shall include in the payment application a line item of \$5,000 for record documents. This cash allowance shall be paid to CONTRACTOR after delivery of final record documents.

**SECTION 105.15: SUBSTANTIAL COMPLETION**

Add the following to the end of Section 105.15:

Outage of Well 15 shall be kept to a minimum during construction. Modification, removal, or replacement of any existing equipment or facilities necessary to keep the facility in operation shall not occur without written authorization from Madison Water Utility. Request to remove the well from service shall be made to the Utility in writing a minimum of 14 calendar days before the planned outage. In general, the facility may be out of service for no longer than 56 calendar days between November 1, 2012

and February 1, 2013; and 28 additional calendar days between April 1, 2013 and June 1, 2013. The Project shall be substantially complete and ready for final payment no later than July 1, 2013.

The Utility reserves the right to evaluate progress and quality of the work in conjunction with the request to remove the facility from service. If it is the opinion of ENGINEER or the Utility that the facility will not be back in service by the specified date or within the specified time, the Utility may delay or deny the request. The Utility reserves the right to maintain the station in service through the summer months if necessary. Any extension of the completion date, demobilization, remobilization, or any other costs associated with an extension because of the lack of progress or quality of the work shall be at no cost to the City and CONTRACTOR shall remain liable for the assessment of liquidated damages.

**SECTION 105.16: GUARANTEE**

Add the following to the end of Section 105.16:

All equipment shall have one year correction period, or longer if specified, beginning from the date of substantial completion.

**SECTION 105.17: PROGRESS SCHEDULE**

Section 105.17 is added as follows:

Within 10 days after delivery of the Notice to Proceed, CONTRACTOR shall submit to OWNER, for approval, an estimated progress schedule indicating the starting and completion dates of the various stages of work, and a preliminary schedule of shop drawing submissions.

Progress schedule shall be updated prior to each construction meeting and an updated schedule submitted with each payment application.

**SECTION 105.18: PRECONSTRUCTION CONFERENCE**

Section 105.18 is added as follows:

Before starting the work at the project sites, a conference will be held to review schedules, to establish procedures for handling shop drawings and other submissions and for processing Applications for Payment, to review list of proposed subcontractors, to establish a working understanding between the parties as to the project, and to discuss project details. Present at the conference will be representatives of the City of Madison, Strand Associates, Inc.®, and CONTRACTOR.

**SECTION 105.19: SCHEDULE OF VALUES OF THE WORK**

Section 105.19 is added as follows:

At least ten days following the issuance of the Notice to Proceed, CONTRACTOR shall submit to ENGINEER a schedule of values of the work. This schedule shall include quantities and unit prices aggregating the Contract price and shall subdivide the work into component parts according to Specification sections in sufficient detail to serve as the basis for progress payments during construction. This schedule, when approved by ENGINEER, shall be used as a basis for CONTRACTOR's Application for Payment.

Include lump sum items in the following amounts in the Schedule of Values:

1. Training \$5,000

2. Operation and Maintenance Manuals \$5,000
3. Record Drawing \$5,000

Payment of these items will only be made upon completion of these items.

**SECTION 106.6: SUBSTITUTE MATERIALS OR EQUIPMENT**

Section 106.6 is added as follows:

Whenever in any of the Contract Documents an article, material, or equipment is defined by describing a proprietary product, or by using the name of a manufacturer or vendor, the term “or equal,” if not inserted, shall be implied. The specific article, material, or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency, and quality desired, and shall not be construed in such a manner as to exclude manufacturer’s products of comparable quality, design and efficiency. If CONTRACTOR wishes to furnish or use a proposed substitute, he shall, prior to the preconstruction conference, make written application to Strand Associates, Inc.<sup>®</sup>, for approval of such a substitute certifying, in writing, that the proposed substitute will perform adequately the functions called for by the general design, be similar and of equal substance to that specified and be suited to the same use and capable of performing the same function as that specified; stating whether or not its incorporation in or use in connection with the project is subject to the payment of any license fee or royalty; and identifying all variations of the proposed substitute from that specified and indicating available maintenance service. No substitute shall be ordered or installed without the written approval of Strand Associates, Inc.<sup>®</sup>, who will be the judge of equality and may require CONTRACTOR to furnish such other data about the proposed substitute as he considers pertinent. No substitute shall be ordered or installed without such performance guarantee and bonds as the City may require which shall be furnished at CONTRACTOR’s expense.

**SECTION 107.1: PROTECTION OF PUBLIC AND UTILITY INTERESTS**

Section 107.1 is amended as follows:

In order to abate objectionable noise to the extent feasible, motorized construction equipment shall not be operated between the hours of 7:00 P.M. and 7:00 A.M. without the prior written approval of ENGINEER.

**SECTION 107.3: INDEMNIFICATION**

Consultant, as included under Section 107.3 of the General Conditions shall include Strand Associates, Inc.<sup>®</sup>

**SECTION 107.4: CONTRACTOR’S LIABILITY INSURANCE**

Section 107.4(j) is added as follows:

On all insurance policies required to be provided by CONTRACTOR, the policies shall include the City of Madison and Strand Associates, Inc.<sup>®</sup>, as their interests may appear and their employees and agents as additional insured.

CONTRACTOR shall purchase and maintain liability insurance, as described above, naming the additional insured’s using Additional Insurance Endorsement Form CG 20 26 07 04, CG 81 11 05 06, CG 20 10 07 04, or equivalent form. General liability policies shall also be endorsed with Form CG 20 37 07 04 to include the “products-completed operations hazard.”

Endorsements or General Liability policy shall not exclude supervisory or inspection services.

CONTRACTOR shall also provide an Additional Insured Endorsement for the automobile policy.

**SECTION 107.14: WEAPONS PROHIBITION**

Contractor shall prohibit, and shall require its subcontractors to prohibit, its employees from carrying weapons, including concealed weapons, in the course of performance of work under this Contract, other than while at the Contractor's or subcontractor's own business premises. This requirement shall apply to vehicles used at any City work site and vehicles used to perform any work under this Contract, except vehicles that are an employee's "own motor vehicle" pursuant to Wis. Stat. sec. 175.60(15m).

**SECTION 108.2: PERMITS AND LICENSING**

Add the following to the end of Section 108.2:

CONTRACTOR shall secure all required building permits.

Madison Water Utility will pay any required building permit fees.

CONTRACTOR shall obtain erosion control permit and shall meet all requirements for installation, maintenance, and reporting requirements.

**SECTION 109.9: LIQUIDATED DAMAGES**

Add the following paragraphs to the end of Section 109.9:

The following milestone dates and liquidated damages shall apply:

Milestone 1; Facility back in service-February 1, 2013. Liquidated damages, as defined in Section 109.9, shall apply for each calendar day that this milestone is not met, or, the facility outage period exceeds 56 calendar days.

Milestone 2; Facility back in-service and ready for the commissioning period-June 1, 2013. Liquidated damages, as defined in Section 109.9, shall apply for each calendar day that these milestones are not met, or, the second facility outage period exceeds 28 calendar days.

Substantial Completion-July 1, 2013. Liquidated damages, as defined in Section 109.9, shall apply for each calendar day that this completion date is not met.

Liquidated damages shall be cumulative with several applying simultaneously.

**SECTION 110.2: PARTIAL PAYMENTS**

Add the following to the end of Section 110.2:

No advanced payment for shop drawing preparation will be made. Shop drawing costs will be paid when equipment and materials are delivered and suitably stored and protected on the site.

All stored equipment and materials for which payment is requested shall have two copies of invoices included with the pay request. Equipment shall be identified thoroughly on the invoices, including serial numbers.

Payment for the stored equipment and material which are on the site shall not exceed the invoiced amount for each item, less the contract retainage. The overhead and profit for the stored items shall not be invoiced until the item is installed.

Payment for off-site storage is normally reserved for sensitive or very large pieces of equipment that in ENGINEER's opinion would not be practical to have stored on the site. Payment for off-site stored items shall be limited to 75% of the invoiced value of the item, less contract retainage. CONTRACTOR shall reimburse OWNER the cost of inspecting off-site stored items. When off-site storage is approved CONTRACTOR shall provide Insurance Certificates and Document of Ownership to OWNER.

No partial payments shall be permitted for line items for training, operation and maintenance manuals, or record drawing called for under Section 105.19.

**SECTION E: PROPOSAL**

**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

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 - 2012 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 to the Contract Nos. \_\_\_\_\_ through \_\_\_\_\_ issued thereto, at the prices for said work as contained in this proposal.
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. Accompanying this Proposal is  Bid Bond or  Certified Check in the amount of \_\_\_\_\_ Dollars (\$\_\_\_\_\_) or  a Certificate of Biennial Bid Bond as required by the Advertisement for Bids.  
*(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 \_\_\_\_\_  
(name of corporation, partnership, or person submitting bid)  
a corporation organized and existing under the laws of the State of \_\_\_\_\_ 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.

\_\_\_\_\_  
SIGNATURE

\_\_\_\_\_  
TITLE, IF ANY

Sworn and subscribed to before me this  
\_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_

\_\_\_\_\_  
(Notary Public or other officer authorized to administer oaths)

My Commission Expires \_\_\_\_\_

Bidders shall not add any conditions or qualifying statements to this Proposal.

**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

State of Wisconsin  
Department of Workforce Development  
Equal Rights Division  
Labor Standards Bureau

**Disclosure of Ownership**

**Notice required under Section 15.04(1)(m), Wisconsin Statutes.** The statutory authority for the use of this form is prescribed in Sections 66.0903(12)(d) and 103.49(7)(d), Wisconsin Statutes. The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes. Personal information you provide may be used for secondary purposes.

- (1) On the date a contractor submits a bid to or completes negotiations with a state agency or local governmental unit, on a project subject to Section 66.0903 or 103.49, Wisconsin Statutes, the contractor shall disclose to such state agency or local governmental unit the name of any "other construction business", which the contractor, or a shareholder, officer or partner of the contractor, owns or has owned within the preceding three (3) years.
- (2) The term "other construction business" means any business engaged in the erection, construction, remodeling, repairing, demolition, altering or painting and decorating of buildings, structures or facilities. It also means any business engaged in supplying mineral aggregate, or hauling excavated material or spoil as provided by Sections 66.0903(3), 103.49(2) and 103.50(2), Wisconsin Statutes.
- (3) This form must ONLY be filed, with the state agency or local governmental unit that will be awarding the contract, if **both (A) and (B) are met.**
  - (A) The contractor, or a shareholder, officer or partner of the contractor:
    - (1) Owns at least a 25% interest in the "other construction business", indicated below, on the date the contractor submits a bid or completes negotiations.
    - (2) Or has owned at least a 25% interest in the "other construction business" at any time within the preceding three (3) years.
  - (B) The Wisconsin Department of Workforce Development (DWD) has determined that the "other construction business" has failed to pay the prevailing wage rate or time and one-half the required hourly basic rate of pay, for hours worked in excess of the prevailing hours of labor, to any employee at any time within the preceding three (3) years.

**Other Construction Business**

Name of Business

Street Address or P O Box	City	State	Zip Code
---------------------------	------	-------	----------

Name of Business

Street Address or P O Box	City	State	Zip Code
---------------------------	------	-------	----------

Name of Business

Street Address or P O Box	City	State	Zip Code
---------------------------	------	-------	----------

**I hereby state under penalty of perjury that the information, contained in this document, is true and accurate according to my knowledge and belief.**

Print the Name of Authorized Officer

Signature of Authorized Officer	Date Signed
---------------------------------	-------------

Name of Corporation, Partnership or Sole Proprietorship

Street Address or P O Box	City	State	Zip Code
---------------------------	------	-------	----------

**If you have any questions call (608) 266-0028**

ERD-7777-E (R. 09/2003)

**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

**Best Value Contracting**

1. The Contractor shall indicate the non-apprenticeable trades used on this contract.

---

---

---

---

---

---

---

---

2. Some Contractors are exempt due to the size of the work force. Apprenticeable trades are those trades considered apprenticeable by the State of Wisconsin.

Check Here if the Contractor has a total skilled work force of four or less individuals in all apprenticeable trades combined. This contractor is exempt from Best Value Contracting.

3. The Contractor shall indicate on page E-4 which apprenticeable trades are to be used on this Contract and shall indicate by checking the appropriate box for the trades used, how the contractor will comply with Madison General Ordinance 33.07(7).

Legend

Number of Journeyworkers	The Contractor shall indicated for trades to be used on this Contract only, the number of journeyworkers that the Contractor has employed company wide.
W-ATT	The Contractor is an active trade trainer in the State of Wisconsin for the trade indicated.
US-ATT	The Contractor is an active trade trainer in an apprenticeship program approved by the U.S. Department of Labor or another state apprenticeship agency in the trade indicated.
SB-ATT	The Contractor shall become an active trade trainer prior to beginning work on the Contract in the trade indicated.

- The Contractor has reviewed the list on page E-4 and shall not use any apprenticeable trades on this project.
- The Contractor has reviewed this list on E-4 and has checked the appropriate box by each apprenticeable trade to be used on the project.

**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

**Apprenticeable Trades**

Check the box in the column "Trade Used on This Project" for each apprenticeable trades used on this project. For those trades used on the project indicated the number of journeyworkers that are employed company wide and check a box to the right of the trade as to how the Contractor will comply MGO 33.07(7). Refer to the legend on page E-3 for the meaning associated with each heading. The Contractor must check one of the boxes on the right for each apprenticeable trade used and checked on the left.

Trade Used on Contract	Apprenticeable Trades	Number of Journeyworkers	W-ATT	US-ATT	SB-ATT
<input type="checkbox"/>	Bricklayer		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Carpenter		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Cement Mason/Concrete Finisher		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Cement Mason (Heavy Highway)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Construction Craft Laborer		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Data Communication Installer		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Electrician		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Environmental Systems Technician/HVAC Service Tech/HVAC Install/Service		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Glazier		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Heavy Equipment Operator/Operating Engineer		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Insulation Worker (Heat & Frost)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Iron Worker		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Iron Worker (Assembler, Metal Bldgs)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Painter & Decorator		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Plasterer		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Plumber		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Residential Electrician		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Roofer & Waterproofer		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Sheet Metal Worker		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Sprinklerfitter		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Steamfitter		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Steamfitter (Refrigeration)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Steamfitter (Service)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Taper & Finisher		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Telecommunications (Voice, Data & Video) Installer-Technician		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Tile Setter		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NAME OF BIDDER: \_\_\_\_\_

**SCHEDULE OF UNIT PRICES AND TOTAL BIDS**

**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

Item No.	Estimated Quantities	Unit	Unit Cost	Total Bid
1.	Well 15 VOC Air Stripper (Entire Project)	Lump Sum	\$ _____	\$ _____

**CASH ALLOWANCES**

The following Cash Allowances will apply in the event that estimated quantities to be included in the Lump Sum Base Bid are different from final measured quantities. A single price shall be bid for each item.

Item Number	Description	Quantity Included in the Lump Sum Base Bid	Unit	Unit Price	Total Amount Included in the Lump Sum Base Bid
1.	Underground Electrical Service Section 16420-Electrical Service System	1	LS	\$1,000	\$1,000
2.	SCADA Software Implements at Master Station Section 16940-Controls and Instrumentation	1	LS	\$15,000	\$15,000
3.	Card Access System Section 16940-Controls and Instrumentation	1	LS	\$5,000	\$5,000
4.	Video Surveillance System Section 16940-Controls and Instrumentation	1	LS	\$5,000	\$5,000

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

\_\_\_\_\_  
Bidders Company Name

\_\_\_\_\_

\_\_\_\_\_  
Company Address

Phone \_\_\_\_\_

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

## **EQUIPMENT ALTERNATIVES**

### **WELL 15 VOC AIR STRIPPER CONTRACT NO. 6941**

The name of the Base Bid Equipment item which Bidder shall include in the Lump Sum Base Bid is listed for each equipment item. Where the name of an Equipment Alternative is listed, Bidder is requested to include an add or deduct to the Base Bid Equipment. Where spaces are provided, Bidder may also bid other Equipment Alternatives by writing in the name of an Equipment Alternative. Equipment Alternative Bid prices shall include the entire cost of the Alternative, including cost for engineering changes to accommodate the Alternative, and additional work (including, but not limited to, structural, mechanical, and electrical work) to be performed which is not shown on the Drawings, but which is required as a result of selection of the Alternative.

Whether or not an Equipment Alternative is offered to one or more of the Base Bid items provided for in the Bid, Bidder shall write (in numbers) the price for providing the Base Bid item, as included in the Lump Sum Base Bid.

When more than one Base Bid manufacturer name is listed for a Base Bid item, CONTRACTOR shall circle the name of the equipment selected for the Lump Sum Base Bid and write in the price for the selected equipment.

**EQUIPMENT ALTERNATIVES**

**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

	Item	Name of Manufacturer Included in the Lump Sum Base Bid  (Circle One)	Cost of Equipment Included in the Lump Sum Base Bid	Alternative Manufacturer	Add to Base Bid for Alternative Manufacturer	Deduct From Base Bid for Alternative Manufacturer
A.	Deep Well Turbine Pump (Section 11216)	ITT-Goulds	\$ _____	_____	(+) _____	(-) _____
				_____	(+) _____	(-) _____
B.	Low Profile Air Stripper (Section 11216)	QED	\$ _____	_____	(+) _____	(-) _____
				_____	(+) _____	(-) _____

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

\_\_\_\_\_  
Bidders Company Name

\_\_\_\_\_  
Company Address

Phone \_\_\_\_\_

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

## SECTION F: BID BOND

KNOW ALL MEN BY THESE PRESENT, THAT \_\_\_\_\_  
(a corporation of the State of \_\_\_\_\_) (individual), (partnership), hereinafter referred to as the "Principal") and \_\_\_\_\_, a corporation of the State of \_\_\_\_\_ (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, (hereinafter referred to as the "Obligee"), in the sum of five per cent (5%) of the amount of the total bid or bids of the Principal herein accepted by the Obligee, for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such that, whereas the Principal has submitted, to the City of Madison a certain bid, including the related alternate, and substitute bids attached hereto and hereby made a part hereof, to enter into a contract in writing for the construction of:

### WELL 15 VOC AIR STRIPPER CONTRACT NO. 6941

1. If said bid is rejected by the Obligee, then this obligation shall be void.
2. If said bid is accepted by the Obligee and the Principal shall execute and deliver a contract in the form specified by the Obligee (properly completed in accordance with said bid) and shall furnish a bond for his/her faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

If said bid is accepted by the Obligee and the Principal shall fail to execute and deliver the contract and the performance and payment bond noted in 2. above executed by this Surety, or other Surety approved by the City of Madison, all within the time specified or any extension thereof, the Principal and Surety agree jointly and severally to forfeit to the Obligee as liquidated damages the sum mentioned above, it being understood that the liability of the Surety for any and all claims hereunder shall in no event exceed the sum of this obligation as stated, and it is further understood that the Principal and Surety reserve the right to recover from the Obligee that portion of the forfeited sum which exceed the actual liquidated damages incurred by the Obligee.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by an extension of the time within which the Obligee may accept such bid, and said Surety does hereby waive notice of any such extension.

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.

Seal

\_\_\_\_\_  
Principal

\_\_\_\_\_  
Date

By:

\_\_\_\_\_

\_\_\_\_\_  
Name of Surety

By:

\_\_\_\_\_

\_\_\_\_\_  
Date

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under License No. \_\_\_\_\_ for the year \_\_\_\_\_, and appointed as attorney in fact with authority to execute this bid bond and the payment and performance bond referred to above, which power of attorney has not been revoked.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Agent

\_\_\_\_\_  
Address

\_\_\_\_\_  
City, State and Zip Code

\_\_\_\_\_  
Telephone Number

#### NOTE TO SURETY & PRINCIPAL

The bid submitted which this bond guarantees may be rejected if the following instrument is not attached to this bond:

Power of Attorney showing that the agent of Surety is currently authorized to execute bonds on behalf of the Surety, and in the amounts referenced above.

## Certificate of Biennial Bid Bond

TIME PERIOD - VALID (FROM/TO)
NAME OF SURETY
NAME OF CONTRACTOR
CERTIFICATE HOLDER <p style="text-align: center;">City of Madison, Wisconsin</p>

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

\_\_\_\_\_  
Date

## SECTION G: AGREEMENT

THIS AGREEMENT made this \_\_\_\_\_ day of \_\_\_\_\_ in the year Two Thousand and Twelve between \_\_\_\_\_ 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 \_\_\_\_\_, \_\_\_\_\_, 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:

### WELL 15 VOC AIR STRIPPER CONTRACT NO. 6941

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 \_\_\_\_\_ (\$\_\_\_\_\_) Dollars being the amount bid by such Contractor and which was awarded to him/her as provided by law.
4. **Wage Rates for Employees of Public Works Contractors**

**General and Authorization.** The Contractor shall compensate its employees at the prevailing wage rate in accordance with section 66.0903, Wis. Stats., DWD 290 of the Wisconsin Administrative Code and as hereinafter provided.

“Public Works” shall include building or work involving the erection, construction, remodeling, repairing or demolition of buildings, parking lots, highways, streets, bridges, sidewalks, street lighting, traffic signals, sanitary sewers, water mains and appurtenances, storm sewers, and the grading and landscaping of public lands.

“Building or work” includes construction activity as distinguished from manufacturing, furnishing of materials, or servicing and maintenance work, except for the delivery of mineral aggregate such as sand, gravel, bituminous asphaltic concrete or stone which is incorporated into the work under contract with the City by depositing the material directly in final place from transporting vehicle.

“Erection, construction, remodeling, repairing” means all types of work done on a particular building or work at the site thereof in the construction or development of the project, including without limitation, erecting, construction, remodeling, repairing, altering, painting, and decorating, the transporting of materials and supplies to or from the building or work done by the employees of the Contractor, Subcontractor, or Agent thereof, and the manufacturing or furnishing of materials, articles, supplies or equipment on the site of the building or work, by persons employed by the Contractor, Subcontractor, or Agent thereof.

“Employees working on the project” means laborers, workers, and mechanics employed directly upon the site of work.

“Laborers, Workers, and Mechanics” include preapprentices, helpers, trainees, learners and properly registered and indentured apprentices but exclude clerical, supervisory, and other personnel not performing manual labor.

**Establishment of Wage Rates.** The Department of Public Works shall periodically obtain a current schedule of prevailing wage rates from DWD. The schedule shall be used to establish the City of Madison Prevailing Wage Rate Schedule for Public Works Construction (prevailing wage rate). The Department of Public Works may include known increases to the prevailing wage rate which can be documented and are to occur on a future specific date. The prevailing wage rate shall be included in public works contracts subsequently negotiated or solicited by the City. Except for known increases contained within the schedule, the prevailing wage rate shall not change during the contract. The approved wage rate is attached hereto.

**Workforce Profile.** The Contractor shall, at the time of signature of the contract, notify the City Engineer in writing of the names and classifications of all the employees of the Contractor, Subcontractors, and Agents proposed for the work. In the alternative, the Contractor shall submit in writing the classifications of all the employees of the Contractor, Subcontractors and Agents and the total number of hours estimated in each classification for the work. This workforce profile(s) shall be reviewed by the City Engineer who may, within ten (10) days, object to the workforce profile(s) as not being reflective of that which would be required for the work. The Contractor may request that the workforce profile, or a portion of the workforce profile, be submitted after the signature of the contract but at least ten (10) days prior to the work commencing. Any costs or time loss resulting from modifications to the workforce profile as a result of the City Engineer’s objections shall be the responsibility of the Contractor.

**Payrolls and Records.** The Contractor shall keep weekly payroll records setting forth the name, address, telephone number, classification, wage rate and fringe benefit package of all the employees who work on the contract, including the employees of the Contractor’s subcontractors and agents. Such weekly payroll records must include the required information for all City contracts and all other contracts on which the employee worked during the week in which the employee worked on the contract. The Contractor shall also keep records of the individual time each employee worked on the project and for each day of the project. Such records shall also set forth the total number of hours of overtime credited to each such employee for each day and week and the amount of overtime pay received in that week. The records shall set forth the full weekly wages earned by each employee and the actual hourly wage paid to the employee.

The Contractor shall submit the weekly payroll records, including the records of the Contractor’s subcontractors and agents, to the City Engineer for every week that work is being done on the contract. The submittal shall be within twenty-one (21) calendar days of the end of the Contractor’s weekly pay period.

Employees shall receive the full amounts accrued at the time of the payment, computed at rates not less than those stated in the prevailing wage rate and each employee's rate shall be determined by the work that is done within the trade or occupation classification which should be properly assigned to the employee.

An employee's classification shall not be changed to a classification of a lesser rate during the contract. If, during the term of the contract, an employee works in a higher pay classification than the one which was previously properly assigned to the employee, then that employee shall be considered to be in the higher pay classification for the balance of the contract, receive the appropriate higher rate of pay, and she/he shall not receive a lesser rate during the balance of the contract. For purposes of clarification, it is noted that there is a distinct difference between working in a different classification with higher pay and doing work within a classification that has varying rates of pay which are determined by the type of work that is done within the classification. For example, the classification "Operating Engineer" provides for different rates of pay for various classes of work and the Employer shall compensate an employee classified as an "Operating Engineer" based on the highest class of work that is done in one day. Therefore, an "Operating Engineer's" rate may vary on a day to day basis depending on the type of work that is done, but it will never be less than the base rate of an "Operating Engineer". Also, as a matter of clarification, it is recognized that an employee may work in a higher paying classification merely by chance and without prior intention, calculation or design. If such is the case and the performance of the work is truly incidental and the occurrence is infrequent, inconsequential and does not serve to undermine the single classification principle herein, then it may not be required that the employee be considered to be in the higher pay classification and receive the higher rate of pay for the duration of the contract. However, the Contractor is not precluded or prevented from paying the higher rate for the limited time that an employee performs work that is outside of the employee's proper classification.

Questions regarding an employee's classification, rate of pay or rate of pay within a classification, shall be resolved by reference to the established practice that predominates in the industry and on which the trade or occupation rate/classification is based. Rate of pay and classification disputes shall be resolved by relying upon practices established by collective bargaining agreements and guidelines used in such determination by appropriate recognized trade unions operating within the City of Madison.

The Contractor, its Subcontractors and Agents shall submit to interrogation regarding compliance with the provisions of this ordinance.

Mulcting of the employees by the Contractor, Subcontractor, and Agents on Public Works contracts, such as by kickbacks or other devices, is prohibited. The normal rate of wage of the employees of the Contractor, Subcontractor, and Agents shall not be reduced or otherwise diminished as a result of payment of the prevailing wage rate on a public works contract.

**Hourly contributions.** Hourly contributions shall be determined in accordance with the prevailing wage rate and with DWD. 290.01(10), Wis. Admin. Code.

**Apprentices and Subjourneypersons.** Apprentices and subjourneypersons performing work on the project shall be compensated in accordance with the prevailing wage rate and with DWD 290.02, and 290.025, respectively, Wis. Admin. Code.

**Straight Time Wages.** The Contractor may pay straight time wages as determined by the prevailing wage rate and DWD 290.04, Wis. Admin. Code.

**Overtime Wages.** The Contractor shall pay overtime wages as required by the prevailing wage rate and DWD 290.05, Wis. Admin. Code.

**Posting of Wage Rates and Hours.** A clearly legible copy of the prevailing wage rate, together with the provisions of Sec. 66.0903(10)(a) and (11)(a), Wis. Stats., shall be kept posted in at least one conspicuous and easily accessible place at the project site by the Contractor and such notice shall remain posted during the full time any laborers, workers or mechanics are employed on the contract.

**Evidence of Compliance by Contractor.** Upon completion of the contract, the Contractor shall file with the Department of Public Works an affidavit stating:

- a. That the Contractor has complied fully with the provisions and requirements of Sec. 66.0903(3), Wis. Stats., and Chapter DWD 290, Wis. Admin. Code; the Contractor has received evidence of compliance from each of the agents and subcontractors; and the names and addresses of all of the subcontractors and agents who worked on the contract.
- b. That full and accurate records have been kept, which clearly indicate the name and trade or occupation of every laborer, worker or mechanic employed by the Contractor in connection with work on the project. The records shall show the number of hours worked by each employee and the actual wages paid therefor; where these records will be kept and the name, address and telephone number of the person who will be responsible for keeping them. The records shall be retained and made available for a period of at least three (3) years following the completion of the project of public works and shall not be removed without prior notification to the municipality.

**Evidence of Compliance by Agent and Subcontractor.** Each agent and subcontractor shall file with the Contractor, upon completion of their portion of the work on the contract an affidavit stating that all the provisions of Sec. 66.0903(3), Wis. Stats., have been fully complied with and that full and accurate records have been kept, which clearly indicate the name and trade or occupation of every laborer, worker or mechanic employed by the Contractor in connection with work on the project. The records shall show the number of hours worked by each employee and the actual wages paid therefor; where these records shall be kept and the name, address and telephone number of the person who shall be responsible for keeping them. The records shall be retained and made available for a period of at least three (3) years following the completion of the project of public works and shall not be removed without prior notification to the municipality.

**Failure to Comply with the Prevailing Wage Rate.** If the Contractor fails to comply with the prevailing wage rate, she/he shall be in default on the contract.

5. **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, 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 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 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 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 Director of Affirmative Action.

## 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 five thousand dollars (\$5,000), 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.



**SECTION H: PAYMENT AND PERFORMANCE BOND**

KNOW ALL MEN BY THESE PRESENTS, that we \_\_\_\_\_  
as principal, and \_\_\_\_\_  
Company of \_\_\_\_\_ as surety, are held and firmly bound unto the City of  
Madison, Wisconsin, in the sum of \_\_\_\_\_ (\$\_\_\_\_\_) 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:

**WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941**

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 \_\_\_\_\_ day of \_\_\_\_\_,

Countersigned:

\_\_\_\_\_  
Company Name (Principal)

\_\_\_\_\_  
Witness

\_\_\_\_\_  
President Seal

\_\_\_\_\_  
Secretary

Approved as to form:

\_\_\_\_\_  
Surety Seal  
 Salary Employee       Commission

\_\_\_\_\_  
City Attorney

By \_\_\_\_\_  
Attorney-in-Fact

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under  
License No. \_\_\_\_\_ for the year 20\_\_\_\_\_, and appointed as attorney-in-fact with  
authority to execute this payment and performance bond which power of attorney has not been revoked.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Agent

# MINIMUM WAGE SCALE

FOR

PUBLIC WORKS IMPROVEMENTS

APPROVED BY: BOARD OF PUBLIC WORKS

MADISON, WISCONSIN

February 7, 2012

The attached "Prevailing Wage Rate Determination: (Pages 1 through 30), issued February 7, 2012, is hereby approved as the Minimum Wage Scale of the City of Madison.

State of Wisconsin Department of Workforce Development Equal Rights Division	<b>DEPARTMENTAL ORDER</b>
<b>ISSUE DATE:</b> 1/13/2012	
<b>PROJECT:</b>	
ALL PUBLIC WORKS PROJECTS UNDER SEC 66.0903, STATS.-CITY OF MADISON MADISON CITY, DANE COUNTY, WI Determination No. 201200105	
<b>PROJECT OWNER:</b>	<b>REQUESTER:</b>
ROBERT F. PHILLIPS, CITY ENGINEER CITY OF MADISON-ENGINEERING 210 MARTIN L KING JR BLVD, RM 115 MADISON, WI 53703	ROBERT F. PHILLIPS, CITY ENGINEER CITY OF MADISON-ENGINEERING 210 MARTIN L KING JR BLVD, RM 115 MADISON, WI 53703
<b>ADDITIONAL CONTACT:</b>	
NORMAN DAVIS, CONTRACT COMPLIANCE CITY OF MADISON-DEPT OF CIVIL RTS-AA DIV 210 MARTIN L KING JR BLVD, RM 523 MADISON, WI 537033342	
<p>The department received an application for prevailing wage rate determination for the above-captioned project. The department conducted a survey to determine the prevailing wage rate for the trade(s) or occupation(s) needed to complete the project. The survey's findings appear in the attached project determination.</p> <p>If you believe that the wage rate for any trade or occupation does not accurately reflect the prevailing wage rate in the city, village or town where the project is located, you may ask the department to conduct an administrative review of such wage rate. You must submit this request in writing within 30 days from the date indicated above. Additionally, your request must include wage rate information from at least three similar projects in the city, village or town where the proposed project is located and on which some work has been performed by the contested trade(s) during the current survey period and was previously considered by the department in issuing the attached determination. See DWD 290.10 of the Wisconsin Administrative Code and either s. 66.0903(3)(br), s. 66.0904(4)(e), or s. 103.49(3)(c), Stats., for a complete explanation of the administrative review process.</p> <p>Enclosures</p>	
<hr/>	
<p>It is hereby ordered that the prevailing wage rates set forth in the attached project determination shall only be applicable to the above referenced project. This order is a <b>FINAL ORDER</b> of the department unless a timely request for an administrative review is filed with the department.</p>	
<p>ISSUED BY:</p> <p style="text-align: center;">           Equal Rights Division            Labor Standards Bureau            Construction Wage Standards Section            PO Box 8928 Madison, WI 53708-8928            (608)266-6861         </p> <p style="text-align: center;">           Web Site: <a href="http://dwd.wisconsin.gov/er/">http://dwd.wisconsin.gov/er/</a> </p>	

**PREVAILING WAGE RATE DETERMINATION**

Issued by the State of Wisconsin  
Department of Workforce Development  
Pursuant to s. 66.0903, Wis. Stats.  
Issued On: 1/13/2012

**DETERMINATION NUMBER:** 201200105

**EXPIRATION DATE:** Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2012. If NOT, You MUST Reapply.

**PROJECT NAME:** ALL PUBLIC WORKS PROJECTS UNDER SEC 66.0903, STATS.-CITY OF MADISON

**PROJECT LOCATION:** MADISON CITY, DANE COUNTY, WI

**CONTRACTING AGENCY:** CITY OF MADISON-ENGINEERING

<b>CLASSIFICATION:</b>	Contractors are responsible for correctly classifying their workers. Either call the Department of Workforce Development (DWD) with trade or classification questions or consult DWD's Dictionary of Occupational Classifications & Work Descriptions on the DWD website at: <a href="http://dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm">dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm</a> .
<b>OVERTIME:</b>	<p>Time and one-half must be paid for all hours worked:</p> <ul style="list-style-type: none"><li>- over 10 hours per day on prevailing wage projects</li><li>- over 40 hours per calendar week</li><li>- Saturday and Sunday</li><li>- on all of the following holidays: January 1; the last Monday in May; July 4; the 1st Monday in September; the 4th Thursday in November; December 25;</li><li>- The day before if January 1, July 4 or December 25 falls on a Saturday;</li><li>- The day following if January 1, July 4 or December 25 falls on a Sunday.</li></ul> <p>Apply the time and one-half overtime calculation to whichever is higher between the Hourly Basic Rate listed on this project determination or the employee's regular hourly rate of pay. Add any applicable Premium or DOT Premium to the Hourly Basic Rate before calculating overtime.</p> <p>A DOT Premium (discussed below) may supersede this time and one-half requirement.</p>
<b>FUTURE INCREASE:</b>	When a specific trade or occupation requires a future increase, you MUST add the full hourly increase to the "TOTAL" on the effective date(s) indicated for the specific trade or occupation.
<b>PREMIUM PAY:</b>	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whenever such pay is applicable.
<b>DOT PREMIUM:</b>	This premium only applies to highway and bridge projects owned by the Wisconsin Department of Transportation and to the project type heading "Airport Pavement or State Highway Construction." DO NOT apply the premium calculation under any other project type on this determination.
<b>APPRENTICES:</b>	Pay apprentices a percentage of the applicable journeyperson's hourly basic rate of pay and hourly fringe benefit contributions specified in this determination. Obtain the appropriate percentage from each apprentice's contract or indenture.
<b>SUBJOURNEY:</b>	Subjourney wage rates may be available for some of the trades or occupations indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer interested in using a subjourney classification on this project MUST complete Form ERD-10880 and request the applicable wage rate from the Department of Workforce Development PRIOR to using the subjourney worker on this project.

This document **MUST BE POSTED** by the **CONTRACTING AGENCY** in at least one conspicuous and easily accessible place on **the site of the project**. A local governmental unit may post this document at the place normally used to post public notices if there is no common site on the project. This document **MUST** remain posted during the entire time any worker is employed on the project and **MUST** be physically incorporated into the specifications and all contracts and subcontracts. If you have any questions, please write to the Equal Rights Division, Labor Standards Bureau, P.O. Box 8928, Madison, Wisconsin 53708 or call (608) 266-6861.

**The following statutory provisions apply to local governmental unit projects of public works and are set forth below pursuant to the requirements of s. 66.0903(8), Stats.**

**s. 66.0903 (1) (f) & s. 103.49 (1) (c) "PREVAILING HOURS OF LABOR"** for any trade or occupation in any area means 10 hours per day and 40 hours per week and may not include any hours worked on a Saturday or Sunday or on any of the following holidays:

1. January 1.
2. The last Monday in May.
3. July 4.
4. The first Monday in September.
5. The 4th Thursday in November.
6. December 25.
7. The day before if January 1, July 4 or December 25 falls on a Saturday.
8. The day following if January 1, July 4 or December 25 falls on a Sunday.

**s. 66.0903 (10) RECORDS; INSPECTION; ENFORCEMENT.**

(a) Each contractor, subcontractor, or contractor's or subcontractor's agent performing work on a project of public works that is subject to this section shall keep full and accurate records clearly indicating the name and trade or occupation of every person performing the work described in sub. (4) and an accurate record of the number of hours worked by each of those persons and the actual wages paid for the hours worked.

**s. 66.0903 (11) LIABILITY AND PENALTIES.**

- (a) 1. Any contractor, subcontractor, or contractor's or subcontractor's agent who fails to pay the prevailing wage rate determined by the department under sub. (3) or who pays less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor is liable to any affected employee in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional amount as liquidated damages as provided under subd. 2., 3., whichever is applicable.
2. If the department determines upon inspection under sub. (10) (b) or (c) that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the department shall order the contractor to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages within a period specified by the department in the order.
3. In addition to or in lieu of recovering the liability specified in subd. 1. as provided in subd. 2., any employee for and in behalf of that employee and other employees similarly situated may commence an action to recover that liability in any court of competent jurisdiction. If the court finds that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the court shall order the contractor, subcontractor, or agent to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages.
5. No employee may be a party plaintiff to an action under subd. 3. unless the employee consents in writing to become a party and the consent is filed in the court in which the action is brought. Notwithstanding s. 814.04 (1), the court shall, in addition to any judgment awarded to the plaintiff, allow reasonable attorney fees and costs to be paid by the defendant.

**BUILDING OR HEAVY CONSTRUCTION**

Includes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

**SKILLED TRADES**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u>	<u>HOURLY FRINGE BENEFITS</u>	<u>TOTAL</u>
		\$	\$	\$
101	Acoustic Ceiling Tile Installer	29.06	15.16	44.22
102	Boilermaker	31.09	23.75	54.84
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add \$.50/hr on 6/1/2012; Add \$ .80 on 6/1/2013 Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.26	16.60	48.86
104	Cabinet Installer	29.06	15.16	44.22
105	Carpenter	29.06	15.16	44.22
106	Carpet Layer or Soft Floor Coverer	29.06	15.16	44.22
107	Cement Finisher	32.03	15.13	47.16
108	Drywall Taper or Finisher	26.10	13.65	39.75
109	Electrician Future Increase(s): Add \$.50/hr on 6/1/2012. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.55	18.68	51.23
110	Elevator Constructor	43.79	25.48	69.27
111	Fence Erector	25.50	0.26	25.76
112	Fire Sprinkler Fitter	36.39	16.75	53.14
113	Glazier	36.23	11.22	47.45
114	Heat or Frost Insulator	33.28	22.51	55.79
115	Insulator (Batt or Blown)	23.62	11.55	35.17
116	Ironworker	30.90	19.11	50.01
117	Lather	29.06	15.16	44.22

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
118	Line Constructor (Electrical)	35.97	18.08	54.05
119	Marble Finisher	31.16	16.27	47.43
120	Marble Mason	32.66	16.20	48.86
121	Metal Building Erector	22.00	4.11	26.11
122	Millwright	30.66	15.21	45.87
123	Overhead Door Installer	18.00	4.86	22.86
124	Painter	25.65	14.11	39.76
125	Pavement Marking Operator	26.00	0.00	26.00
126	Piledriver	29.56	15.16	44.72
127	Pipeline Fuser or Welder (Gas or Utility)	29.54	18.84	48.38
129	Plasterer	29.03	15.16	44.19
130	Plumber	36.20	15.02	51.22
132	Refrigeration Mechanic Future Increase(s): Add \$.85/hr on 12/1/11; Add \$.90/hr on 6/1/12; Add \$.85/hr on 12/1/12.	40.35	16.21	56.56
133	Roofer or Waterproofing	28.06	0.00	28.06
134	Sheet Metal Worker	34.23	20.19	54.42
135	Steamfitter Future Increase(s): Add \$.85/hr on 12/1/11; Add \$.90/hr on 6/1/12; Add \$.85/hr on 12/1/12.	40.35	16.21	56.56
137	Teledata Technician or Installer	21.26	6.99	28.25
138	Temperature Control Installer	32.55	18.68	51.23
139	Terrazzo Finisher	18.00	5.35	23.35
140	Terrazzo Mechanic	31.16	16.27	47.43
141	Tile Finisher Future Increase(s): Add \$.50/hr on 6/1/2012; Add \$ .80/hr on 6/1/2013.	23.77	16.00	39.77
142	Tile Setter Future Increase(s): Add \$.50/hr on 6/1/2012; Add \$ .80/hr on 6/1/2013.	29.71	16.00	45.71
143	Tuckpointer, Caulker or Cleaner	22.00	9.75	31.75
144	Underwater Diver (Except on Great Lakes)	36.20	18.81	55.01
146	Well Driller or Pump Installer	25.32	15.30	40.62

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
147	Siding Installer	16.74	2.58	19.32
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	32.37	16.48	48.85
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.78	15.16	43.94
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	17.80	9.00	26.80
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	23.38	12.48	35.86
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.30	10.97	32.27

**TRUCK DRIVERS**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
201	Single Axle or Two Axle	18.00	6.98	24.98
203	Three or More Axle Future Increase(s): Add \$1.57/hr on 6/1/2012.	18.00	13.83	31.83
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	31.89	17.98	49.87
205	Pavement Marking Vehicle	19.25	10.84	30.09
207	Truck Mechanic	18.00	13.68	31.68

**LABORERS**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
301	General Laborer Future Increase(s): Add \$.50/hr. on 06/04/2012; Add \$.75/hr. on 06/03/2013 Premium Increase(s): Add \$1.00/hr for certified welder; Add \$.25/hr for mason tender	24.14	13.45	37.59
302	Asbestos Abatement Worker	23.96	12.88	36.84
303	Landscaper	17.00	6.36	23.36
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	20.39	12.20	32.59
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
314	Railroad Track Laborer	14.00	4.77	18.77

**HEAVY EQUIPMENT OPERATORS  
SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u>	<u>HOURLY FRINGE BENEFITS</u>	<u>TOTAL</u>
		\$	\$	\$
501	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	32.42	17.98	50.40
502	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under).	31.89	14.44	46.33
503	Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	31.89	17.98	49.87
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	36.20	18.81	55.01
505	Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator. Premium Increase(s): Add \$.50/hr for friction crane, lattice boom or crane certification (CCO).	37.45	19.45	56.90

**Fringe Benefits Must Be Paid On All Hours Worked**

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
506	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	26.80	18.52	45.32
507	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	27.75	19.15	46.90

**HEAVY EQUIPMENT OPERATORS  
EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK**

**Fringe Benefits Must Be Paid On All Hours Worked**

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
508	Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013. Premium Increase(s): Add \$.50/hr at 200 ton; Add \$1.00/hr. at 300 ton; Add \$1.50/hr at 400 ton; Add \$2.00/hr at 500 ton.	34.62	17.98	52.60
509	Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over). Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013. Premium Increase(s): Add \$.25/hr for cranes with lifting capacity of 45 ton or over.	33.62	17.98	51.60
510	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screeed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type). Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	32.42	17.98	50.40

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
511	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	31.89	17.98	49.87
512	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.	35.59	19.10	54.69
513	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	29.19	17.98	47.17
514	Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment). Future Increase(s): Add \$2/hr. on 1/1/2013.	34.89	19.68	54.57
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment).	30.32	17.40	47.72
516	Fiber Optic Cable Equipment	22.00	7.27	29.27

**SEWER, WATER OR TUNNEL CONSTRUCTION**

Includes those projects that primarily involve public sewer or water distribution, transmission or collection systems and related tunnel work (excluding buildings).

**SKILLED TRADES**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u>	<u>HOURLY FRINGE BENEFITS</u>	<u>TOTAL</u>
		\$	\$	\$
103	Bricklayer, Blocklayer or Stonemason	32.66	16.20	48.86
105	Carpenter Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.43	19.31	52.74
107	Cement Finisher Future Increase(s): Add \$1.86 on 6/1/12; Add \$1.87 on 6/1/13; Add \$1.87 on 6/1/14; Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	30.68	15.68	46.36
109	Electrician Future Increase(s): Add \$1.40/hr on 6/1/2012. Add \$1.60/hr on 6/1/2013. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	31.54	20.95	52.49
111	Fence Erector	25.50	0.26	25.76
116	Ironworker Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	31.31	22.22	53.53
118	Line Constructor (Electrical)	35.97	18.08	54.05
125	Pavement Marking Operator	26.00	0.00	26.00
126	Piledriver	29.56	15.16	44.72
130	Plumber	36.20	15.02	51.22
135	Steamfitter	39.90	15.76	55.66
137	Teledata Technician or Installer	21.26	6.99	28.25

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
143	Tuckpointer, Caulker or Cleaner	22.00	9.75	31.75
144	Underwater Diver (Except on Great Lakes)	36.20	18.81	55.01
146	Well Driller or Pump Installer	24.22	14.80	39.02
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	32.37	16.48	48.85
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.78	15.16	43.94
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	17.80	9.00	26.80
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	23.38	12.48	35.86
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.30	10.97	32.27

**TRUCK DRIVERS**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
201	Single Axle or Two Axle	23.00	8.64	31.64
203	Three or More Axle	21.17	9.51	30.68
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.75/hr on 6/1/2012; Add \$1.85/hr on 6/1/2013. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	22.50	16.19	38.69
205	Pavement Marking Vehicle	19.25	10.84	30.09
207	Truck Mechanic	21.17	9.51	30.68

**LABORERS**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
301	General Laborer Future Increase(s): Add \$.70/hr. on 06/04/2012; Add \$.80/hr. on 06/03/2013 Premium Increase(s): Add \$.20 for blaster, bracer, manhole builder, caulker, bottomman and power tool; Add \$.55 for pipelayer; Add \$1.00 for tunnel work 0-15 lbs. compressed air; Add \$2.00 for over 15-30 lbs. compressed air; Add \$3.00 for over 30 lbs. compressed air.	25.28	13.44	38.72

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
303	Landscaper	17.00	6.36	23.36
304	Flagperson or Traffic Control Person	12.00	17.89	29.89
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
314	Railroad Track Laborer	14.00	4.77	18.77

**HEAVY EQUIPMENT OPERATORS  
SEWER, WATER OR TUNNEL WORK**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
521	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver. Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013. Premium Increase(s): Add \$.25/hr for cranes with lifting capacity of 45 ton or over.	33.62	17.98	51.60
522	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skid Rig; Telehandler; Traveling Crane (Bridge Type). Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	32.42	17.98	50.40

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
523	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	31.89	17.98	49.87
524	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.	30.89	17.16	48.05
525	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	29.19	17.98	47.17
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler.	29.19	17.96	47.15
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	36.20	18.81	55.01
528	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	36.20	18.81	55.01

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b><u>CODE</u></b>	<b><u>TRADE OR OCCUPATION</u></b>	<b><u>HOURLY BASIC RATE OF PAY</u></b>	<b><u>HOURLY FRINGE BENEFITS</u></b>	<b><u>TOTAL</u></b>
		<b>\$</b>	<b>\$</b>	<b>\$</b>
529	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	26.80	18.52	45.32
530	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	26.80	18.52	45.32

<b>AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION</b>
---

Includes all airport projects (excluding buildings) and all projects awarded by the Wisconsin Department of Transportation (excluding buildings).

<b>SKILLED TRADES</b>
-----------------------

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
103	Bricklayer, Blocklayer or Stonemason	32.66	15.92	48.58
105	Carpenter	30.23	15.16	45.39
107	Cement Finisher Future Increase(s): Add \$1.86 on 6/1/12; Add \$1.87 on 6/1/13; Add \$1.87 on 6/1/14; Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	30.68	15.68	46.36
109	Electrician	37.25	14.68	51.93
111	Fence Erector	35.62	0.00	35.62
116	Ironworker	30.90	19.11	50.01
118	Line Constructor (Electrical)	35.97	18.08	54.05
124	Painter	28.00	11.15	39.15
125	Pavement Marking Operator	26.65	14.92	41.57
126	Piledriver	29.56	15.16	44.72
133	Rofer or Waterproofer	28.06	0.00	28.06
137	Teledata Technician or Installer	21.26	6.99	28.25
143	Tuckpointer, Caulker or Cleaner	22.00	9.75	31.75
144	Underwater Diver (Except on Great Lakes)	36.20	18.81	55.01
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.42	12.90	48.32
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	35.50	14.27	49.77
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.18	14.07	39.25
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	23.38	12.48	35.86

154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.30	10.97	32.27
-----	---	-------	-------	-------

**TRUCK DRIVERS**

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
201	Single Axle or Two Axle Future Increase(s): Add \$1.75/hr on 6/1/2012; Add \$1.85/hr on 6/1/2013. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	22.35	16.19	38.54
203	Three or More Axle Future Increase(s): Add \$1.75/hr on 6/1/2012; Add \$1.85/hr on 6/1/2013. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	22.50	16.19	38.69
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	24.91	15.63	40.54
205	Pavement Marking Vehicle	23.84	14.76	38.60
206	Shadow or Pilot Vehicle	24.76	15.35	40.11
207	Truck Mechanic	24.91	15.35	40.26

**LABORERS**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
301	General Laborer Future Increase(s): Add \$1.60/hr on 6/1/2012; Add \$1.70/hr on 6/1/2013; Add \$1.60/hr on 6/1/2014. Premium Increase(s): Add \$.10/hr for topman, air tool operator, vibrator or tamper operator (mechanical hand operated), chain saw operator and demolition burning torch laborer; Add \$.15/hr for bituminous worker (raker and luteman), formsetter (curb, sidewalk and pavement) and strike off man; Add \$.20/hr for blaster and powderman; Add \$.25/hr for bottomman; Add \$.35/hr for line and grade specialist; Add \$.45/hr for pipelayer. / DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	27.20	13.45	40.65
302	Asbestos Abatement Worker	23.96	12.88	36.84
303	Landscaper Future Increase(s): Add \$1.60/hr on 6/1/12; Add \$1.70/hr on 6/1/13; Add \$1.60/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	27.20	13.45	40.65
304	Flagperson or Traffic Control Person Future Increase(s): Add \$1.60/hr on 6/1/2012; Add \$1.70/hr on 6/1/2013; Add \$1.60/hr on 6/1/2014. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	23.55	13.45	37.00

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
314	Railroad Track Laborer	14.00	4.77	18.77

**HEAVY EQUIPMENT OPERATORS  
AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
531	Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Traveling Crane (Bridge Type). Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	34.22	18.90	53.12
532	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs., & Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.72	18.90	52.62

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
533	<p>Air Track, Rotary or Percussion Drilling Machine &amp;/or Hammers, Blaster; Asphalt Heater, Planer &amp; Scarifier; Asphalt Milling Machine; Asphalt Screed; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. &amp; Under); Bituminous (Asphalt) Plant &amp; Paver, Screed; Boatmen (NOT Performing Work on the Great Lakes); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibration/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb &amp; Gutter Machine; Concrete Spreader &amp; Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches &amp; A-Frames.</p> <p>Future Increase(s):                      Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.</p> <p>Premium Increase(s):                      DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day &amp; Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).</p>	33.22	18.90	52.12

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
534	<p>Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed &amp; Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver &amp; Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine.</p> <p>Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.</p> <p>Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day &amp; Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).</p>	32.96	18.90	51.86
535	<p>Air Compressor (&amp;/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical &amp; Horizontal); Automatic Belt Conveyor &amp; Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&amp;/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.</p> <p>Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.</p> <p>Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day &amp; Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).</p>	32.67	18.90	51.57
536	Fiber Optic Cable Equipment.	22.00	7.27	29.27
537	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	36.20	18.81	55.01

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b><u>CODE</u></b>	<b><u>TRADE OR OCCUPATION</u></b>	<b><u>HOURLY BASIC RATE OF PAY</u></b>	<b><u>HOURLY FRINGE BENEFITS</u></b>	<b><u>TOTAL</u></b>
		<b>\$</b>	<b>\$</b>	<b>\$</b>
538	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	36.20	18.81	55.01
539	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	26.80	18.52	45.32
540	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks-Great Lakes ONLY.	26.80	18.52	45.32

<b>LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION</b>
--

Includes roads, streets, alleys, trails, bridges, paths, racetracks, parking lots and driveways (except residential or agricultural), public sidewalks or other similar projects (excluding projects awarded by the Wisconsin Department of Transportation).

<b>SKILLED TRADES</b>
-----------------------

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
103	Bricklayer, Blocklayer or Stonemason	32.66	16.20	48.86
105	Carpenter	29.06	15.16	44.22
107	Cement Finisher Future Increase(s): Add \$1.86 on 6/1/12; Add \$1.87 on 6/1/13; Add \$1.87 on 6/1/14; Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	30.68	15.68	46.36
109	Electrician Future Increase(s): Add \$.50/hr. effective 06/04/2012. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	28.74	17.86	46.60
111	Fence Erector	25.50	0.26	25.76
116	Ironworker	30.90	19.11	50.01
118	Line Constructor (Electrical)	35.97	18.08	54.05
124	Painter	25.65	14.11	39.76
125	Pavement Marking Operator	26.00	0.00	26.00
126	Piledriver	29.56	15.16	44.72
133	Rofer or Waterproofer	28.06	0.00	28.06
137	Teledata Technician or Installer	21.26	6.99	28.25
143	Tuckpointer, Caulker or Cleaner	22.00	9.75	31.75
144	Underwater Diver (Except on Great Lakes)	36.20	18.81	55.01
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.42	12.90	48.32

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		<b>\$</b>	<b>\$</b>	<b>\$</b>
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	29.64	14.64	44.28
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.18	13.07	38.25
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	23.38	12.48	35.86
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.30	10.97	32.27
<b>TRUCK DRIVERS</b>				

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		<b>\$</b>	<b>\$</b>	<b>\$</b>
201	Single Axle or Two Axle	15.00	0.00	15.00
203	Three or More Axle	19.50	4.97	24.47
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1/hr on 6/3/2012; Add \$1/hr on 6/2/2013.	31.89	17.98	49.87
205	Pavement Marking Vehicle	19.25	10.84	30.09
206	Shadow or Pilot Vehicle	15.00	0.00	15.00
207	Truck Mechanic	19.50	4.97	24.47

**LABORERS**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		<b>\$</b>	<b>\$</b>	<b>\$</b>
301	General Laborer	26.15	12.29	38.44
303	Landscaper	23.71	15.07	38.78
304	Flagperson or Traffic Control Person	12.00	17.89	29.89
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
314	Railroad Track Laborer	14.00	4.77	18.77

**HEAVY EQUIPMENT OPERATORS  
CONCRETE PAVEMENT OR BRIDGE WORK**

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>				
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
		\$	\$	\$
541	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	34.22	18.90	53.12
542	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.72	18.90	52.62

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
543	<p>Air Track, Rotary or Percussion Drilling Machine &amp;/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. &amp; Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb &amp; Gutter Machine; Concrete Spreader &amp; Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches &amp; A-Frames.</p> <p>Future Increase(s):                      Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.</p> <p>Premium Increase(s):                      DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day &amp; Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).</p>	33.22	18.90	52.12

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
544	Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.22	18.90	52.12
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.	30.42	17.58	48.00
546	Fiber Optic Cable Equipment.	22.00	7.27	29.27
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	36.20	18.81	55.01
548	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	36.20	18.81	55.01
549	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	26.80	18.52	45.32
550	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	26.80	18.52	45.32

**HEAVY EQUIPMENT OPERATORS  
ASPHALT PAVEMENT OR OTHER WORK**

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
551	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	34.62	17.96	52.58
552	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.72	18.90	52.62

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
553	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.	32.67	18.55	51.22
554	Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler.	31.52	17.89	49.41
555	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.	32.67	18.55	51.22
556	Fiber Optic Cable Equipment.	22.00	7.27	29.27

<b>RESIDENTIAL OR AGRICULTURAL CONSTRUCTION</b>
---

Includes single family houses or apartment buildings of no more than four (4) stories in height and all buildings, structures or facilities that are primarily used for agricultural or farming purposes, excluding commercial buildings. For classification purposes, the exterior height of a residential building, in terms of stories, is the primary consideration. All incidental items such as site work, driveways, parking lots, private sidewalks, private septic systems or sewer and water laterals connected to a public system and swimming pools are included within this definition. Residential buildings of five (5) stories and above are NOT included within this definition.

<b>SKILLED TRADES</b>
-----------------------

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
101	Acoustic Ceiling Tile Installer	27.00	2.47	29.47
102	Boilermaker	31.09	23.75	54.84
103	Bricklayer, Blocklayer or Stonemason	32.00	3.00	35.00
104	Cabinet Installer	22.00	2.74	24.74
105	Carpenter	27.00	3.46	30.46
106	Carpet Layer or Soft Floor Coverer	23.95	2.78	26.73
107	Cement Finisher	21.33	4.25	25.58
108	Drywall Taper or Finisher	23.80	1.55	25.35
109	Electrician	22.00	9.18	31.18
110	Elevator Constructor	43.79	25.48	69.27
111	Fence Erector	17.64	4.33	21.97
112	Fire Sprinkler Fitter	36.39	16.97	53.36
113	Glazier	36.23	11.22	47.45
114	Heat or Frost Insulator	29.04	19.73	48.77
115	Insulator (Batt or Blown)	18.95	1.70	20.65
116	Ironworker	30.90	19.11	50.01
117	Lather	28.15	15.14	43.29
119	Marble Finisher	31.16	16.27	47.43
120	Marble Mason	32.66	16.20	48.86
121	Metal Building Erector	17.50	2.80	20.30
123	Overhead Door Installer	17.00	0.00	17.00
124	Painter	25.65	6.33	31.98
125	Pavement Marking Operator	26.00	0.00	26.00

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
129	Plasterer	19.00	0.29	19.29
130	Plumber	30.00	10.34	40.34
132	Refrigeration Mechanic	30.96	0.00	30.96
133	Roofer or Waterproofer	29.85	1.55	31.40
134	Sheet Metal Worker	21.03	3.40	24.43
135	Steamfitter	32.59	11.05	43.64
137	Teledata Technician or Installer	19.23	5.32	24.55
138	Temperature Control Installer	22.45	4.11	26.56
139	Terrazzo Finisher	18.00	5.35	23.35
140	Terrazzo Mechanic	31.16	16.27	47.43
141	Tile Finisher	23.96	13.36	37.32
142	Tile Setter	21.00	0.00	21.00
143	Tuckpointer, Caulker or Cleaner	23.96	12.88	36.84
146	Well Driller or Pump Installer	15.10	12.38	27.48
147	Siding Installer	18.80	1.42	20.22

---

**TRUCK DRIVERS**

---

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
201	Single Axle or Two Axle	19.86	2.54	22.40
203	Three or More Axle	19.50	14.27	33.77
205	Pavement Marking Vehicle	19.25	10.84	30.09
207	Truck Mechanic	19.00	1.75	20.75

---

**LABORERS**

---

<b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b>		<b>HOURLY BASIC RATE OF PAY</b>	<b>HOURLY FRINGE BENEFITS</b>	<b>TOTAL</b>
<b>CODE</b>	<b>TRADE OR OCCUPATION</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
301	General Laborer	16.09	7.18	23.27
302	Asbestos Abatement Worker	17.00	2.21	19.21
303	Landscaper	25.00	0.54	25.54

311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
-----	--	-------	------	-------

**HEAVY EQUIPMENT OPERATORS  
RESIDENTIAL OR AGRICULTURAL CONSTRUCTION**

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
557	Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type); Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Crane, Shovel, Dragline, Clamshells; Forestry Equipment, Timberco, Tree Shear, Tub Grinder, Processor; Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type); Winches & A-Frames.	29.45	15.37	44.82
558	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Backfiller; Belting, Burlap, Texturing Machine; Boiler (Temporary Heat); Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Jeep Digger; Lift Slab Machine; Mulcher; Oiler; Post Hole Digger or Driver; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Roller (Rubber Tire, 5 Tons or Under); Screed (Milling Machine); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Stump Chipper; Telehandler; Vibratory Hammer or Extractor, Power Pack.	26.45	14.35	40.80

\*\*\*\*\* END OF RATES \*\*\*\*\*

SECTION 00010

TABLE OF CONTENTS

WELL 15 VOC AIR STRIPPER  
CONTRACT NO. 6941  
CITY OF MADISON, WISCONSIN

Pages  
Through

DIVISION 1–GENERAL REQUIREMENTS

SUMMARY OF WORK .....	01010- 5
CONTRACT CONSIDERATIONS .....	01019- 2
COORDINATION, FIELD ENGINEERING, AND MEETINGS.....	01039- 3
CUTTING, PATCHING, AND ALTERATIONS.....	01045- 6
REGULATORY REQUIREMENTS.....	01060- 2
REFERENCE STANDARDS AND DEFINITIONS .....	01090- 6
SUBMITTALS .....	01300-11
QUALITY CONTROL.....	01400- 2
TEMPORARY FACILITIES .....	01500- 3
TEMPORARY CONTROLS .....	01560- 3
FIELD OFFICES AND SHEDS.....	01590- 2
MATERIALS AND EQUIPMENT .....	01600- 4
STARTING OF SYSTEMS.....	01650- 3
CONTRACT CLOSEOUT .....	01700- 3

DIVISION 2–SITE WORK

DEMOLITION .....	02050- 4
SITE CLEARING AND STRIPPING .....	02110- 2
DEWATERING.....	02140- 3
EXCAVATION, FILL, BACKFILL, AND GRADING.....	02222- 6
EXPANDED POLYSTYRENE GEOFOAM FILL .....	02225- 2
AGGREGATE BASE COURSE.....	02231- 2
SLOPE PROTECTION AND EROSION CONTROL.....	02270- 5
HOT MIX ASPHALT PAVING .....	02510- 4
BURIED PIPING AND APPURTENANCES.....	02600- 7
VEHICLE GATE.....	02831- 2
SEEDING AND SODDING.....	02936- 5
TREES, PLANTS, STONE MULCH, AND EDGING .....	02950- 4

DIVISION 3–CONCRETE

CONCRETE FORMWORK.....	03100- 4
CONCRETE REINFORCEMENT.....	03200- 5
CAST-IN-PLACE CONCRETE .....	03300-16
PRECAST CONCRETE HOLLOW CORE PLANKS.....	03415- 5

TABLE OF CONTENTS Continued

	Pages Through
<u>DIVISION 4–MASONRY</u>	
MORTAR AND MASONRY GROUT.....	04100- 3
UNIT MASONRY SYSTEM.....	04300- 8
<u>DIVISION 5–METALS</u>	
COLD FORMED STEEL FRAMING.....	05400- 6
METAL FABRICATIONS.....	05500- 7
GRATINGS.....	05531- 2
ANCHOR BOLTS, EXPANSION BOLTS, AND ADHESIVE ANCHORS.....	05560- 3
<u>DIVISION 6–WOOD AND PLASTIC</u>	
WOOD FRAMING AND SHEATHING.....	06112- 2
WOOD BLOCKING AND CURBING.....	06114- 2
<u>DIVISION 7–THERMAL AND MOISTURE PROTECTION</u>	
RUBBERIZED ASPHALT MEMBRANE.....	07112- 2
VAPOR AND AIR BARRIER.....	07191- 1
BOARD INSULATION.....	07212- 2
BATT INSULATION.....	07213- 1
FIRESTOPPING.....	07270- 3
ALUMINUM COMPOSITE PANELS.....	07420- 7
EXTRUDED GLASS FIBER CONCRETE PANEL RAINSCREEN CLADDING SYSTEM	07460- 6
SINGLE-PLY ROOFING–FULLY ADHERED.....	07531- 4
PREPARATION FOR REROOFING.....	07565- 1
FLASHING AND SHEET METAL.....	07620- 3
MANUFACTURED ROOF SPECIALTIES.....	07710- 2
ROOF HATCHES.....	07724- 1
CAULKING AND SEALANTS.....	07900- 3
<u>DIVISION 8–DOORS AND WINDOWS</u>	
FIBERGLASS DOORS AND ALUMINUM FRAMES.....	08220- 2
STEEL WINDOWS.....	08505- 4
DOOR HARDWARE.....	08710- 4
GLAZING.....	08800- 2
<u>DIVISION 9–FINISHES</u>	
GYPSUM BOARD.....	09250- 4
RESINOUS FLOORING.....	09670- 3
PAINTING.....	09900-10

TABLE OF CONTENTS Continued

	Pages Through
<u>DIVISION 10–SPECIALTIES</u>	
PLASTIC AND METAL SIGNS .....	10441- 2
FIRST AID KIT .....	10520- 1
FIRE EXTINGUISHERS AND ACCESSORIES .....	10522- 2
TOILET AND BATH ACCESSORIES .....	10800- 3
<u>DIVISION 11–EQUIPMENT</u>	
DEEP WELL TURBINE PUMP .....	11216- 7
LOW PROFILE AIR STRIPPERS .....	11236- 7
CHLORINATION EQUIPMENT .....	11261- 3
FLUORIDATION EQUIPMENT .....	11270- 2
<u>DIVISION 12–FURNISHINGS</u>	
FLOOR MATS.....	12692- 1
<u>DIVISION 15–MECHANICAL</u>	
GENERAL REQUIREMENTS FOR MECHANICAL WORK.....	15000- 3
PIPING AND ACCESSORIES.....	15040-13
EQUIPMENT IDENTIFICATION.....	15195- 3
MECHANICAL INSULATION .....	15250- 3
HEATING, VENTILATION, AND AIR CONDITIONING INSULATION .....	15290- 3
WATER BASED FIRE PROTECTION .....	15300-13
PLUMBING.....	15400- 5
NATURAL GAS SERVICE SYSTEM .....	15420- 1
HYDRONIC PIPING AND SPECIALTIES.....	15510- 3
FUEL-FIRED UNIT HEATERS.....	15625- 3
DEHUMIDIFICATION EQUIPMENT .....	15820- 1
TERMINAL HEAT TRANSFER UNITS.....	15835- 2
AIR HANDLING UNITS.....	15855- 4
CENTRIFUGAL FANS .....	15860- 4
DUCTWORK .....	15890- 4
DUCTWORK ACCESSORIES .....	15910- 5
AIR OUTLETS AND INLETS.....	15940- 2
TESTING, ADJUSTING, AND BALANCING.....	15990- 5
<u>DIVISION 16–ELECTRICAL</u>	
GENERAL ELECTRICAL REQUIREMENTS.....	16010- 9
CONDUIT .....	16110- 7
HANDHOLES .....	16112- 2
WIRE.....	16120- 6
BOXES.....	16130- 4
WIRING DEVICES.....	16141- 6
SUPPORTING DEVICES.....	16190- 2
ELECTRICAL IDENTIFICATION.....	16195- 3
SURGE PROTECTIVE DEVICES (SPD).....	16412- 4
ELECTRICAL SERVICE SYSTEM.....	16420- 2
DISCONNECT SWITCHES .....	16440- 2
SECONDARY GROUNDING .....	16450- 4

TABLE OF CONTENTS Continued

	Pages Through
MOTOR CONTROL .....	16480-14
LIGHTING.....	16500-10
FIRE ALARM SYSTEM.....	16723-20
INSTRUMENT AND COMMUNICATION WIRE AND CABLE .....	16930- 6
CONTROLS AND INSTRUMENTATION .....	16940-34
SHORT CIRCUIT, COORDINATION, AND ARC FLASH HAZARD STUDY .....	16949- 5
SPARE PARTS .....	16951- 2
SCADA SYSTEM I/O LISTING .....	16990- 5

DRAWINGS

STANDARD DETAIL–SANITARY SEWER APPURTENANCES .....	01-975- 43A
STANDARD DETAIL–SANITARY SEWER LATERALS .....	01-975- 75A
STANDARD DETAIL–PROJECT SIGN LAYOUT .....	01-975-158A

APPENDICES (Not Part of Contract Documents)

GEOTECHNICAL INVESTIGATION.....	19
---------------------------------	----

END OF SECTION

## **SPECIFICATIONS**

## SECTION 01010

### SUMMARY OF WORK

#### PART 1–GENERAL

##### 1.01 DIVISION ONE

- A. The requirements of Division 1 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. The Madison Water Utility operates the Well 15 facility continuously. Well 15 is a major source of water supply for the east side of the City of Madison. The well is visited by Water Utility staff once a day. Chemical deliveries are made to the site on a regular basis as needed. Madison Gas and Electric operates and maintains the generator set on the facility property.
2. When the facility is in operation, it shall be the responsibility of CONTRACTOR to not in any way impair the normal operation of the facility. CONTRACTOR shall maintain hard surface access to the entrance to the chemical room, generator set, and front door throughout construction.
3. Operation of the water supply and treatment facilities will be the responsibility of OWNER. CONTRACTOR shall cooperate with the water utility operation staff at all times.
4. CONTRACTOR shall submit for review, a detailed outage plan for time periods when the well facility will be taken out of service. The plan shall be in writing and in the form of a bar chart. The outage plan may be part of the construction schedule if adequately detailed and shall be updated monthly.

### 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 facility operations. 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.
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 facility. Any modifications to this general construction sequence shall be proposed in writing and shall be approved by OWNER before their implementations.
3. Before being placed into service or returned to service, all new or existing piping, tanks, and equipment shall be cleaned and disinfected. Reservoirs shall be disinfected before returning them to service after each shutdown period, even if no work was performed in the reservoir.
4. See Special Provisions for allowable project shutdown periods and milestone requirements.
5. The existing well, booster pump, reservoir, and chemical addition will remain in service, except when the facility is removed from service as defined in the Special Provisions. When the facility is removed from service, the City shall pump reservoir down to the low level with the existing pumping equipment. CONTRACTOR shall be responsible for removing and disposing of the remaining water from the reservoir.
6. During the first shutdown period, as defined by Milestone 1 in the Special Provisions, CONTRACTOR shall complete all necessary improvements and modifications necessary to construct the addition over the existing reservoir. Any penetrations into the reservoir shall be sanitary sealed with secured overlapping covers or gasketed blind flanges when returned to operation. CONTRACTOR shall provide any temporary

sealing mechanisms. CONTRACTOR shall protect all penetrations and prevent water from collecting near the penetrations throughout construction. The limit switches monitoring the status of the reservoir entrance hatches shall remain functional at all times when the facility is in service.

7. As defined by Milestone 2 in the Special Provisions, CONTRACTOR shall complete all work to have the facility back in service and ready for the commissioning period.
8. CONTRACTOR may perform work within the existing facility while the facility is online. CONTRACTOR's work shall not interfere with normal operation of the existing facility.
9. The existing electrical equipment and controls will remain in place and operational while the new building addition is being completed. The new motor control center, associated controls, and utility service may be installed in the new building addition during this time. Once the new electrical equipment, conduit, and wire are installed, the existing electrical equipment and controls that will remain may be relocated to the new motor control center, supervisory control center, and lighting panel. Any relocations requiring removal of the facility from service shall occur during defined shutdown periods listed in the Special Provisions.

#### 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, or the 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. No access shall be permitted from the Lien Road intersection.

#### 1.06 EXISTING SERVICES, STRUCTURES, AND UNDERGROUND FACILITIES

- A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security systems, and similar work shall be kept to an absolute minimum and shall be limited to times approved by OWNER.
- 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 piping or other utilities be encountered during installation, notify OWNER and consult with utility owner immediately for directions.
- E. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation, and repair any damaged utilities to satisfaction of utility owner.
- F. CONTRACTOR shall not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.
- G. Any accidental interruption of services 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. CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of structures and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such structures and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.
- J. CONTRACTOR shall keep an accurate and complete record of all such structures 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.
- K. CONTRACTOR shall inspect all structures and Underground Facilities for condition and soundness. Unsound conditions shall be reported to the structure or facility owner immediately after exposing. CONTRACTOR shall not proceed with the work until the structure or facility owner has been notified. OWNER shall then be given time to inspect and correct, if required, the structure 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.
- L. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing structure or Underground Facility encountered shall be paid for by CONTRACTOR.
- M. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing structures 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.

#### 1.08 AVAILABILITY OF LANDS

- A. Easements were obtained for this project. CONTRACTOR shall contain its operation to within the rights-of-way or lands upon which the work is to be performed.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01019

### 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. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. Cash Allowances:
  - 1. Contractor agrees that:
    - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
    - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. Contingency Allowance: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.
- E. Refer to sections of the specifications identified in the Bid Form for specific information on use of cash allowances.
- F. The Bid shall include the amount equal to the specified quantity times the unit price.

##### 1.03 MEASUREMENT AND PAYMENT–LUMP SUM

- A. No separate measurement for payment will be performed for Lump Sum Work.
- B. CONTRACTOR shall estimate percentage of Work completed. ENGINEER will review CONTRACTOR's estimate of quantity of Work completed.
- C. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.
- D. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings shall be included in the Lump Sum Bid.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01039

### COORDINATION, FIELD ENGINEERING, AND MEETINGS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Coordination.
  - 2. Field engineering.
  - 3. Progress meetings.
  - 4. Preinstallation meetings.

##### 1.02 COORDINATION

- A. CONTRACTOR shall coordinate scheduling, submittals, and work of the various sections of the work to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later. See Section 01010—Summary of Work for specific construction sequence.
- B. CONTRACTOR shall verify utility requirements and characteristics of operating equipment are compatible with building utilities and coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.
- C. CONTRACTOR shall coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings and shall follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, except as otherwise indicated, CONTRACTOR shall conceal pipes, ducts, and wiring within the construction and coordinate locations of fixtures and outlets with finish elements.
- E. CONTRACTOR shall coordinate completion and clean up of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's occupancy.
- F. After OWNER occupancy of premises, CONTRACTOR shall coordinate access to Site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of OWNER's activities.

##### 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.

#### 1.04 PROGRESS MEETINGS

- A. Progress meetings will be held throughout progress of the Work at intervals agreed to by OWNER, ENGINEER, and CONTRACTOR. Interval will generally be monthly.
- B. CONTRACTOR's project manager, job superintendent, major subcontractors, and suppliers shall attend as appropriate to address agenda topics for each meeting. CONTRACTOR's representatives shall have authority to bind CONTRACTOR to decisions at the meetings.
- C. The project schedule shall be updated monthly and shall be reviewed at each progress meeting. CONTRACTOR shall provide the following information in written form at each meeting.
  - 1. Construction progress, including:
    - a. Activities completed this reporting period.
    - b. Activities in progress this reporting period.
    - c. Activities scheduled to commence this reporting period.
  - 2. Description of problem areas.
  - 3. Current and anticipated delays.
    - a. Cause of the delay.
    - b. Corrective action and schedule adjustments to correct the delay.
    - c. Impact of the delay on other activities, on milestones, and on completion dates.
  - 4. Changes in construction sequence.
- D. ENGINEER will prepare and distribute minutes to all attending parties.

## 1.05 PREINSTALLATION MEETING

- A. When required in individual specification sections, CONTRACTOR shall convene a preinstallation meeting at Work Site prior to commencing Work of the section.
- B. CONTRACTOR shall require attendance of parties directly affecting or affected by work of the specific section.
- C. CONTRACTOR shall notify ENGINEER seven days in advance of meeting date.
- D. CONTRACTOR shall prepare agenda and preside at meeting:
  - 1. Review conditions of installation, preparation, and installation procedures.
  - 2. Review coordination with related work.
- E. CONTRACTOR shall record minutes and distribute copies to participants within two days after meeting; two copies to ENGINEER, participants, and those affected by decisions made.

## PART 2-PRODUCTS

NOT APPLICABLE

## PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01045

### 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.

#### 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 01060

### 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. City of Madison Planning Approval has been obtained. The following permits have been applied for by OWNER:
  - 1. WDNR Water Supply Approval.
  - 2. PSC Authorization to Construct.
- B. CONTRACTOR shall comply with all provisions of these permits and shall be responsible for notifications as required by these permits. 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. However, OWNER will waive fees associated with the permit.
- D. CONTRACTOR shall provide erosion control plan in accordance with Madison General Ordinances. The plan shall be submitted to OWNER for submission to City Planning Department at least one week prior to obtaining building permit.
- E. Any permits required for dewatering operations shall be obtained and paid for by CONTRACTOR.
- 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. CONTRACTOR shall also comply with the wage rates established by OWNER and applicable provisions of Section 66.0903 of the State of Wisconsin Statutes.
- B. Not less than the prevailing wage rates for this area shall be paid to the workers employed to do the Work under this Contract.
- C. CONTRACTOR shall comply with all provisions of Section 66.0903 and Section 103.49 of the Wisconsin Statutes, and Wisconsin Administrative Code Chapter DWD 290. Unless exempted by Statute, CONTRACTOR shall comply with the following:
  - 1. Subsection 66.0903(10)(a) requires that records be kept of employee's names, trades or occupation, hours worked, and wages paid.
  - 2. Subsection 66.0903(8) requires that a copy of the wage rate determination, if issued for this project, be posted in at least one conspicuous and easily accessible place at the site of the project.
  - 3. Subsection 66.0903(9)(b) requires that each agent or Subcontractor furnish evidence to CONTRACTOR of compliance with Subsection 66.0903(10).
  - 4. Subsection 66.0903(9)(c) requires that upon completion of the Project and prior to final payment, CONTRACTOR must file with the municipality an affidavit stating that it has complied fully with the provisions and requirements of the wage rate determination and that CONTRACTOR has received evidence of compliance from each of its agents and Subcontractors. A municipality may not authorize final payment until such an affidavit is filed in proper form and order. See attached form.
- D. See Wage Rate Forms bound after Section H Payment and Performance Bond. The forms bound in this document may not include all forms that may be applicable to your project. CONTRACTOR shall check the DWD Website for other applicable or updated forms.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01090

### 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  
                  900 19th Street, NW, Washington, DC 20006
2. AAMA        American Architectural Manufacturer's Association  
                  1827 Walden Office Square, Schaumburg, IL 60173
3. AASHTO     American Association of State Highway & Transportation Officials  
                  444 North Capitol Street, NW, Washington, DC 20001
4. ACI           American Concrete Institute  
                  38800 Country Club Drive, Farmington Hills, MI 48331
5. AI            Asphalt Institute  
                  Research Park Drive, P.O. Box 14052, Lexington, KY 40512-4052
6. AISC         American Institute of Steel Construction  
                  One East Wacker Drive, Suite 3100, Chicago, IL 60601-2001
7. AISI         American Iron and Steel Institute  
                  1101 17th Street, NW, Suite 1300, Washington, DC 20036
8. ANSI         American National Standards Institute  
                  11 West 42nd Street, New York, NY 10036
9. APA          American Plywood Association  
                  7011 So. 19th, Tacoma, WA 98466

10. API American Petroleum Institute  
12201 L Street, NW, Washington, DC 20005-4070
11. ARI Air-Conditioning & Refrigeration Institute  
4100 N. 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  
Three Park Avenue, New York, NY 10016-5990
14. ASSE American Society of Sanitary Engineering  
901 Canterbury, Suite A, Westlake, OH 44145
15. ASTM American Society for Testing and Materials  
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
16. AWI Architectural Woodwork Institute  
1952 Isaac Newton Square West, Reston, VA 20190
17. AWPA American Wood-Preserver's Association  
P.O. Box 388, Selma, AL 36702-0388
18. AWS American Welding Society  
550 N.W. LeJune Road, Miami, FL 33126
19. AWWA American Waterworks Association  
6666 West Quincey Avenue, Denver, CO 80235
20. BHMA Builder's Hardware Manufacturers Association  
355 Lexington Avenue, 17th floor; New York, NY 10017
21. BIA Brick Industry Association  
11490 Commerce Park Drive, Reston, VA 20191-1525
22. CRSI Concrete Reinforcing Steel Institute  
9333 N. Plum Grove Road, Schaumburg, IL 60173
23. EJMA Expansion Joint Manufacturers Association  
25 North Broadway, Tarrytown, NY 10591
24. FM Factory Mutual System  
FM Global Corporate Offices, 1301 Atwood Avenue, PO Box 7500,  
Johnston, RI 02919
25. FS Federal Specification (General Services Admin.)  
Bldg. 197, Washington Navy Yard; Washington, DC 20407
26. FTI Facing Tile Institute  
Box 8880, Canton, OH 44711

- 27. GA            Gypsum Association  
810 1st St., NE, Washington, DC 20002
  
- 28. GANA        Glass Association of North America  
2945 SW Wanamaker Drive, Suite A, Topeka, KS 66614
  
- 29. IESNA        Illuminating Engineering Society of North America  
120 Wall Street, Floor 17, New York, NY 10005
  
- 30. MIL          Military Specifications  
Naval Publications and Forms Center  
5801 Tabor Avenue, Philadelphia, PA 19120
  
- 31. NAAMM      National Association of Architectural Metal Manufacturers  
8 South Michigan Avenue, Suite 1000, Chicago, IL 60603
  
- 32. NCMA        National Concrete Masonry Association  
13750 Sunrise Valley Drive, Herndon, VA 20171-4662
  
- 33. 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 1847, Rosslyn, VA 22209
  
- 35. NFPA        National Fire Protection Association  
1 Batterymarch Park, Quincy, MA 02169-7471
  
- 36. NIS          National Institute of Standards  
(U.S. Department of Commerce), 100 Bureau Drive, Stop 3460  
Gaithersburg, MD 20899-3460
  
- 37. NRCA        National Roofing Contractors Association  
10255 W. Higgins Road, Suite 600, Rosemont, IL 60018
  
- 38. NSF          National Sanitation Foundation International  
P.O. Box 130140, 789 N. 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  
209 W. Jackson Blvd., Chicago, IL 60606-6938
  
- 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 Rd., Cleveland, OH 44145-1987
- 45. SIGMA        Sealed Insulating Glass Manufacturers Assoc.  
401 N. Michigan Avenue, Chicago, IL 60611-4267
- 46. SJI            Steel Joist Institute  
3127 10th Ave. North Ext., Myrtle Beach, SC 29577-6760
- 47. SMACNA      Sheet Metal and Air Conditioning  
Contractor's National Association  
4201 Lafayette Center Drive, Chantilly, VA 20151-1209
- 48. SSPC         Society for Protective Coatings  
40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656
- 49. TCA           Tile Council of America  
100 Clemson Research Blvd., Anderson, SC 29625
- 50. UBC           Uniform Building Code  
5360 Workman Mill Road; Whittier, CA 90601-2298
- 51. 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 the standard specifications.
  - 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 01300

### 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 progress schedule, shop drawings, product data, samples, 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 6 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 SCHEDULE

- A. Submit initial schedule in duplicate within 10 days after date of OWNER-CONTRACTOR Agreement.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Submit a horizontal bar chart with separate line for each major portion of Work or operation, identifying first workday of each week.
- E. 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.
- F. Indicate estimated percentage of completion for each item of Work at each submission.
- G. 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 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 25% completion of the Work. Applications for payment beyond 25% of the Contract amount will not be recommended for payment until all shop drawings are submitted 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. Hard copy shop drawings shall be submitted in 3-ring binders or 3-tab report covers.
- G. 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."
- H. 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.
- I. All shop drawings used for construction site activities shall bear the "Approved" or "Approved as Noted" stamp of ENGINEER.
- J. Arrangements may be made between CONTRACTOR and ENGINEER to provide additional copies of "Approved" shop drawings for field activity purposes.
- K. Electronic Submittal Procedures:
  - 1. Summary:
    - a. Shop drawing and product data submittals shall be transmitted to ENGINEER in electronic (PDF) format using Submittal Exchange, or equal, a website service designed specifically for transmitting submittals between construction team members, or equal.
    - b. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
    - c. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
  - 2. Procedures:
    - a. Submittal Preparation—CONTRACTOR may use any or all of the following options:
      - (1) Subcontractors and Suppliers provide electronic (PDF) submittals to CONTRACTOR via the Submittal Exchange website, or equal.
      - (2) Subcontractors and Suppliers provide paper submittals to CONTRACTOR who electronically scans and converts to PDF format.
      - (3) Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
    - b. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.
    - c. CONTRACTOR shall transmit each submittal to ENGINEER using the Submittal Exchange website, [www.submittalexchange.com](http://www.submittalexchange.com), or equal.

- d. ENGINEER review comments will be made available on the Submittal Exchange website for downloading. CONTRACTOR will receive email notice of completed review.
  - e. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of CONTRACTOR.
  - f. Electronically submitted shop drawings shall follow the following format:
    - (1) Filenames for the shop drawing submittals shall follow a XXXXX.YYY-Z. Description convention where XXXXX is the specification section number, YYY is the submittal number, .Z is the resubmittal number, and description is a short description of what the submittal includes. Submittals shall be consecutively numbered in direct sequence of submittal. Resubmittals shall be consecutively numbered with the first submittal numbered with an -0 and the first resubmittal numbered with a -1.
      - (a) Example file name: 03200.016-1. Structure 10 Concrete Reinforcement. This would be the first revision of the sixteenth submittal and contain information on concrete reinforcement.
    - (2) 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.
    - (3) Files shall be delivered without security features activated.
    - (4) 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.
    - (5) 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.
  - g. 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.
3. Costs:
- a. CONTRACTOR shall include the full cost of Submittal Exchange, or equal, project subscription in their proposal. This cost shall be included in the Contract amount. Contact Submittal Exchange at 1-800-714-0024 to verify cost prior to Bid.
  - b. At CONTRACTOR's option, training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 1-800-714-0024.
  - c. Internet Service and Equipment Requirements:
    - (1) Email address and Internet access at CONTRACTOR's main office.
    - (2) Adobe Acrobat (www.adobe.com) , Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

- L. CONTRACTOR is fully responsible for obtaining any and all copyright permission associated with conversion of shop drawing information to electronic format.

#### 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 MOCK-UPS

- A. CONTRACTOR shall provide samples and field mock-ups 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 mock-ups:
  - 1. CONTRACTOR shall erect field mock-ups at the project site in a location acceptable to ENGINEER and OWNER.
  - 2. When accepted by ENGINEER, the mock-up will become the basis for comparison of the actual work.
  - 3. Remove mock-up 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. Electronic shop drawing resubmissions shall follow the nomenclature described in Section 1.06.J.2.f.

#### 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 50% 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 and an electronic format compact disk of the maintenance manual in the most recent version of Adobe (.pdf) format identical to the hard copy. Applications for payment beyond 50% 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. 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.

- C. 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 (XXXXX\_YY.PDF) where XXXXX 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.
- D. (Example: 19876\_01a.pdf). 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.
- E. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document form (\*.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.
- F. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.
- G. 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).
- H. Thumbnails shall be generated and embedded in each PDF file.
- I. Files shall be delivered without Security features activated. Password protected files will be unacceptable.
- J. 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
- K. 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.
- L. The submittal shall be delivered on CD after all Equipment O&M Manuals have been received and approved. Each CD shall be labeled, at a minimum, as follows, including:
  - 1) CD-ROM disks, 2) jewel cases, and 3) hard copies.

- M. Manufacturer name, point of contact, telephone number, facsimile number, and e-mail address as appropriate.
- N. Equipment name and/or O&M title spelled out in complete words.
  - Example "Operations and Maintenance Manual"
  - "Horizontal Centrifugal Nonclog Pump"
- O. Specifications section number.
- P. Project name.
- Q. Date and File Name: Example "12-20-07", "19876\_01.pdf"
- R. CONTRACTOR shall reprocess any portion of the document that does not view or print to OWNER's satisfaction.
- S. CONTRACTOR is fully responsible for obtaining any and all copyright permissions associated with conversion of this information to electronic format.
- T. 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, preventive maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and start-up procedures and, where applicable, test data and curves. All sheets shall have reduced dimensions as described for shop drawings, and shall be furnished in 3-ring binders or 3-tab report covers.
- U. Two copies shall be submitted in a 3-ring binder or 3-tab report cover, and the remaining copies shall be furnished in 3-tab report covers, binder clips, or large envelopes.
- V. 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.
- W. All sheets have reduced dimensions as described for shop drawings, and shall be furnished in 3-ring binders or 3-tab report covers.

## 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>
-------------	--------------------------------------	-----------------	--------------------------------	----------------------------

PREVENTATIVE 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</u>	<u>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 01400

### 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 01500

### TEMPORARY FACILITIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Temporary utilities.
  - 2. Temporary stairs and access.
  - 3. Temporary support facilities.
  - 4. Construction sign.
  - 5. 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:
  - 1. CONTRACTOR shall provide weather protection to protect the Work from damage because of freezing, rain, snow, and other inclement weather.
  - 2. No permanent heating equipment shall be used on a temporary basis without express written permission by OWNER. Such approval, if given, shall not affect the guarantee period. If OWNER authorizes use of permanent heating equipment, CONTRACTOR shall pay all related energy costs until acceptance or occupancy (whichever occurs first) of the building by OWNER.
- D. Temporary Telephone Service: CONTRACTOR shall provide, without extra cost to OWNER, telephone services at the Site for phones and computer modems specified in Section 01590–Field Offices and Sheds for the duration of the Work at the Site. Also provide service as required for CONTRACTOR's use. Party making toll calls shall pay for same.
- E. 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.
- F. 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.

#### 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 CONSTRUCTION SIGN

- A. Furnish and erect a construction sign to be maintained and kept in place until completion of the Contract.
- B. The sign shall be minimum 4 feet high by 8 feet wide, constructed by a professional sign painter, and shall show the name of the Project, OWNER, all prime contractors and ENGINEER. ENGINEER will furnish a sketch showing the printing. OWNER will select colors of paint required. General sign layout shall be as shown on Drawing 01-975-158A attached at the end of these Specifications. General sign layout shall be as approved by OWNER.

1.06 REMOVAL OF TEMPORARY FACILITIES

- A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to substantial 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.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01560

### 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 and City of Madison Requirements.

### 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. Do not close or obstruct roadways without approval of OWNER.
- C. Maintain two-way traffic on streets at all times.
- D. Conduct operations with minimum interference to roadways.

### 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. CONTRACTOR shall at a minimum maintain a 6-foot-tall chain link construction fence. Adequately pad locked gate shall be provided for site access. ENGINEER and OWNER shall be provided with keys.

### 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 01590

### 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, pre-finished 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 01600–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.

### 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 01600

### 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 assure:
  - 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. Available storage space at the Site is limited. 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 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 01650

### STARTING OF SYSTEMS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Starting equipment and systems.
  - 2. Demonstration and instructions.
  - 3. Start-up and testing.
  - 4. Commissioning period.
- B. CONTRACTOR shall perform the Work described in the following subsections.

##### 1.02 STARTING EQUIPMENT AND SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify ENGINEER and OWNER a minimum of seven days prior to start-up of each item.
- C. 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.
- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.
- G. 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.
- H. 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.
- I. Provide lubricants as recommended by manufacturer appropriate for start-up conditions.

##### 1.03 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to OWNER's personnel.
- B. For all mechanical equipment or systems, demonstrate project equipment and instruct in a classroom environment at a location acceptable to the OWNER and instructed by qualified manufacturers' representative who is knowledgeable about the Project.

- C. For equipment or systems requiring seasonal operation, perform demonstration for noncurrent season at start of noncurrent season.
- D. 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.
- E. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time at equipment location.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- G. Supervision and Start-up: Installation of all equipment furnished under this Contract shall be supervised as required by a qualified representative of equipment manufacturer. All equipment shall be placed in operation by a qualified representative of the equipment manufacturer and the staff 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 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.

#### 1.04 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 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.

#### 1.05 COMMISSIONING PERIOD

- A. Prior to final acceptance and following successful start-up, the Station shall undergo a 7-day commissioning period. During the commissioning period, CONTRACTOR and subcontractors shall be available to provide service no later than the following business

day when notified by OWNER that an operational problem exists. If service is required during the commissioning period, the period shall be extended 7 days. The commissioning period shall be completed once 7 days of satisfactory operation without need for service have been completed.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01700

### 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.
  - 6. Spare parts and maintenance materials.

##### 1.02 CLOSEOUT PROCEDURES

- A. CONTRACTOR shall provide submittals to ENGINEER that are required by governing or other authorities.
- B. CONTRACTOR shall comply with Standard Specifications 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 ensure 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 ensure entries 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 Documents and Shop 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.

## 1.07 SPARE PARTS AND MAINTENANCE MATERIALS

- A. CONTRACTOR shall provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections.

## PART 2-PRODUCTS

NOT APPLICABLE

## PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 02050

### DEMOLITION

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: All demolition, removal, and salvage work as shown on the drawings or specified herein.
- B. Related Sections and Divisions: Applicable provisions of Division 1 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.

##### 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 1 of these specifications and in accordance with the construction phases of this project and work to be done by other contractors.

#### PART 2–PRODUCTS

##### 2.01 GENERAL

- A. Compacted fill shall meet the requirements of Section 02222–Excavation, Fill, Backfill and Grading.
- B. Pipe fittings and materials shall meet the requirements of Section 02600–Buried Piping and Appurtenances and Section 15050-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 non-shrink grout unless noted otherwise.
- B. Pavement, Curb, Gutter, Sidewalk, Driveways, Crosswalk, 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.

### 3.02 ABANDONING STRUCTURES

- A. Tanks, Manholes, Catch Basins, and Inlets:
1. CONTRACTOR shall thoroughly clean structures to be abandoned.
  2. CONTRACTOR shall plug existing pipe connections with brick or concrete block masonry or with any grade of concrete having a 28-day compressive strength in excess of 2,000 psi.
  3. CONTRACTOR shall remove the walls of the structures to an elevation at least 2 feet below the finished grade line, or to such elevation that may be designated on the drawings or as necessary to clear new construction.

### 3.03 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.

### 3.04 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 major equipment items or systems. CONTRACTOR shall remove all items indicated or specified to be removed.

### 3.05 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.

### 3.06 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.
- D. The following equipment and materials shall be removed and reused in the new facilities:
  - 1. Chlorination system.
  - 2. Chlorine leak detector.
- E. The following equipment and materials shall be removed and turned over to OWNER:
  - 1. Gauge panel and associated pressure transducers.
  - 2. Air compressor.
  - 3. Differential pressure transducer.
  - 4. Electrical devices as noted.

### 3.07 BACKFILL

- A. CONTRACTOR shall fill all abandoned structures and excavations resulting from removal of structures and utilities with compacted fill. See Section 02222–Excavation, Fill, Backfill, and Grading for required degree of compaction.
- B. Before filling, CONTRACTOR shall break one opening in the floor or wall near the base of each compartment to allow groundwater to freely migrate through the structure.

END OF SECTION

## SECTION 02110

### SITE CLEARING AND STRIPPING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Removal of surface debris.
  - 2. Removal of paving, curbs, and sidewalks.
  - 3. Removal of trees, shrubs, and other plant life.
  - 4. Strip and stockpile topsoil.
- B. Related Sections and Divisions: Applicable provisions of Division 1 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. CONTRACTOR shall protect trees, plant growth, and features designated to remain as final landscaping.
- C. See Division 1 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, curb and gutter, and sidewalks 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 02140

### DEWATERING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Removal of groundwater to allow below grade construction.
  - 2. Site grading to prevent surface water from entering the excavation.
- B. Related Sections and Divisions: Applicable provisions of Division 1 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 prices 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 1, Regulatory Requirements for permit requirements and water, erosion, and sediment control.

##### 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 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.
- C. CONTRACTOR shall meet all requirements of applicable WDNR permits for construction pit or trench dewatering.
- D. 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 02222

### 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 granular mat vapor barrier and granular cushion below interior slabs on grade.
  - 4. Rough and finish grading prior to paving, seeding, etc.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Payment:
  - 1. General excavation shall include all excavation specified, undercutting, fill, backfill and grading, including rock excavation hereinafter described.
  - 2. All general excavation shall be included in the Lump Sum Bid.

##### 1.02 REFERENCES

- A. ASTM D1557—Test Methods for Moisture Density Relations of Soils and Soil—Aggregate Mixtures using 10 pound Rammer and 18-inch drop.
- B. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current 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 if it meets the above specification. CONTRACTOR shall determine whether native material meets the above specification. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

### 2.02 GRANULAR CUSHION

- A. Granular cushion beneath floor slabs-on-grade shall meet requirements of Section 305 of Standard Specifications for WisDOT Base Aggregate Dense, 3/4 inch.

### 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 CONCRETE FILL

- A. Concrete fill shall be Class X concrete as defined in Section 03300 Cast-In-Place Concrete or flowable fill as defined in this section.

### 2.05 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, pits, 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 02140–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. CONTRACTOR shall backfill and compact all overexcavated areas.

### 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.
- C. All road subgrades shall be proofrolled with a heavy rubber-tired construction vehicle (such as a fully loaded tandem-axle dump truck) in the presence of the Project Soils Engineer.

### 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. Unless otherwise noted, structures with a top slab shall not be backfilled until the slab is in place and has reached its specified 28-day strength.
- C. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.
- D. No fill shall be placed under water or over unsuitable subgrade conditions.
- E. 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 buildings, structures, piping, bituminous roadway and parking areas, curb and gutter, and backfill within ten 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.

- F. No frozen material shall be placed nor shall any material be placed on frozen ground.
- G. 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 CONCRETE FILL

- A. In areas where there is inadequate room for compaction equipment and in other areas as shown or specified, Class X concrete shall be used as fill material.

### 3.10 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.

### 3.11 PLACING GRANULAR CUSHION AND VAPOR BARRIER

- A. When subgrade is prepared for slab-on-grade areas, CONTRACTOR shall place, compact, and finish grade with a 6-inch layer of granular cushion, then place vapor barrier over the granular cushion.

### 3.12 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 02225

### EXPANDED POLYSTYRENE GEOFOAM FILL

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Section includes expanded polystyrene (EPS) geofoam.
- B. Related Sections: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM D6817–Standard Specification for Rigid, Cellular Polystyrene Geofoam.

##### 1.03 SUBMITTALS

- A. Submit EPS Geofoam manufacturer’s product literature and TechData, including:
  - 1. Physical properties in compliance with ASTM D6817 Type specified.
  - 2. A 10-year physical property warranty.
- B. Shop drawings showing EPS geofoam block layout.
- C. Quality Assurance: Submit the following:
  - 1. Summary of test compliance with specified performance characteristics and physical properties.
  - 2. Manufacturer shall supply a product certificate showing evidence of third-party quality control.

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

- A. Deliver EPS geofoam labeled with material type.
- B. Store aboveground and protected from moisture and sunlight before installation.
- C. Product should not be exposed to open flame or other ignition sources.

##### 1.05 WARRANTY

- A. Provide EPS geofoam 10-year warranty covering the long-term physical property of expanded polystyrene geofoam.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS/SUPPLIERS

- A. ACH Foam Technologies, LLC, 90 Trowbridge Drive, Fond du Lac, WI 54936-0660 or equal.

## 2.02 EPS GEOFOAM

- A. Foam-control EPS geofoam, type EPS12, in compliance with ASTM D6817.
- B. All foam-control EPS geofoam blocks shall be treated by the manufacturer with a tested and proven termite treatment for below grade applications, 3-year minimum field exposure. The treatment shall be EPA registered, meet requirements of ICC ES AC239, and be recognized in an ICC ES report.

## 2.03 GEOGRIPPER® PLATES

- A. GeoGripper® plates shall be used to restrain EPS geofoam from moving laterally in layer-over-layer applications. The GeoGripper® plate shall be manufactured by AFM Corporation. The plate shall be made of galvanized or stainless steel with two-sided multi-barbed design capable of piercing geofoam. Each plate shall be capable of a lateral holding strength of 60 pounds.
- B. Two plates for each 4-foot by 8-foot section of EPS block is a minimum recommendation to minimize block-to-block movement during installation.

## PART 3-EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. CONTRACTOR shall comply with manufacturer's EPS geofoam product data including technical bulletins.

### 3.02 PREPARATION AND INSTALLATION

- A. CONTRACTOR shall verify conditions of substrate, grade, and other conditions that affect installation of geofoam.
- B. CONTRACTOR shall install manufacturer's recommendations and as shown on drawings.

### 3.03 PROTECTION

- A. CONTRACTOR shall protect installed product and finish surfaces from damage during construction as required.

END OF SECTION

## SECTION 02231

### AGGREGATE BASE COURSE

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Aggregate base course for roads and parking areas.
  - 2. Gravel roads.
- B. Related Sections and Divisions: Applicable provisions of Division 1 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 02510–Asphaltic Concrete Paving.

##### 1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.

##### 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 01300-Submittals.

##### 1.05 DRAINAGE DURING CONSTRUCTION

- A. CONTRACTOR shall comply with the provisions of Section 205.3.3.

#### PART 2–PRODUCTS

##### 2.01 AGGREGATES

- A. Aggregate for base course shall meet the requirements of Sections 301 and 305.

- 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 tri-axle 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 provided according to the standard cross sections provided on the drawings.
- 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.
- F. All gravel surfaces damaged during construction shall be replaced. The depth of aggregate shall match existing or 8 inches, whichever is greater.

END OF SECTION

## SECTION 02270

### 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 1 shall govern work in this section.

##### 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. Erosion Control Product Applicability List for Multi-Modal Applications (PAL) Wisconsin Department of Transportation.
- C. Dane County Erosion Control and Stormwater Management Manual ([www.co.dane.wi.us/landconservation/ecswpg.htm](http://www.co.dane.wi.us/landconservation/ecswpg.htm))

##### 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.

##### 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

### 2.01 EROSION CONTROL PRODUCTS

- A. Erosion control products shall be as listed in the *Erosion Control Product Acceptability List for Multi-Modal Applications (PAL)* of the Wisconsin Department of Transportation. Contractors may obtain copies of the PAL and PAL qualification procedures from the WisDOT Bureau of Highway Construction.

### 2.02 EROSION MATS

- A. Erosion mat products shall be selected from the PAL in conformance with criteria specified in Conservation Practice Standard 1052 (Non-channel Erosion Mat) and 1053 (Channel Erosion Mat).
- B. Unless designated on the drawings, CONTRACTOR may furnish any prequalified erosion mat product of the class and type listed in the PAL.
- C. A 300 mm by 300 mm sample of a product proposed for erosion mat may be required to verify that it is prequalified. When a sample is required, it shall be accompanied by the manufacturer's literature for the proposed product.

### 2.03 SILT FENCE

- A. Silt fence shall conform to Conservation Practice Standard 1056-Silt Fence. Silt fence shall conform to Table 2 of Conservation Practice Standard 1056.
- B. Furnish wrapping on each roll of fabric to protect the fabric from ultraviolet radiation and from abrasion during shipping and handling. Keep geotextile dry until installed.

### 2.04 SOIL STABILIZER

- A. Soil stabilizer shall be Type A or Type B. Type A is either a cementitious soil binder added to wood cellulose fiber mulch or a bonded fiber matrix. Type B is a water soluble anionic polyacrylamide meeting requirements specified in Conservation Practice Standard 1050-Land Application of Anionic Polyacrylamide. CONTRACTOR shall provide soil stabilizer products from the PAL.

### 2.05 INLET PROTECTION

- A. Inlet protection shall conform to Conservation Practice Standard 1060-Storm Drain Inlet Protection for Construction Sites. Manufactured bags shall conform to Table 1 of Conservation Practice Standard 1060.

### 2.06 STONE TRACKING PADS AND TIRE WASHING STATION

- A. Stone tracking pads and tire washing stations shall conform to Conservation Practice Standard 1057-Stone Tracking Pad and Tire Washing.

## 2.07 TEMPORARY SEEDING

- A. Temporary seeding for construction site erosion control shall conform to Conservation Standard Practice 1059-Seeding for Construction Site Erosion Control.

## PART 3–EXECUTION

### 3.01 GENERAL

- A. Install devices before construction activities begin.
- B. Proceed carefully with construction adjacent to stream channels to avoid washing, sloughing, or deposition of materials into the stream. If possible, the work area should be diked off and the volume and velocity of water that crosses disturbed areas be reduced by means of planned engineering works (diversion, detention basins, berms).
- C. Unless noted on drawings, do not remove trees and surface vegetation.
- D. Expose the smallest practical area of soil at any given time through construction scheduling. Make the duration of such exposure before application of temporary erosion control measures or final revegetation as short as practicable.
- E. CONTRACTOR shall provide a “qualified” inspector to inspect erosion control and sediment controls once in place. Inspector shall have prior experience with and knowledge of installation and maintenance of erosion and pollution controls. Unless stricter requirements are mandated by DNR or by any local permits, project site erosion control inspection shall be conducted every seven days and after each one-half-inch rainfall or greater. CONTRACTOR shall maintain hard copies of the inspection reports for the duration of the Project.
- F. Any necessary repairs to erosion and sediment control facilities shall be provided within 24 hours to all corrective measures noted on the inspection reports to address pollution issues. CONTRACTOR shall submit to OWNER a written notice stating the times, dates and actions taken to rectify the defective erosion and sediment controls.
- G. CONTRACTOR shall also make any necessary additions for erosion and sediment control as may result from on-site conditions or the progress of the Work or as may be required by DNR or OWNER.
- H. Disturbed areas shall be stabilized with temporary or permanent measures within 14 calendar days of the soil disturbance or redistribution.
- I. All temporary erosion and sediment control measures shall be removed within 30 days after final stabilization is achieved or after the temporary measures are no longer needed. All sediment accumulated in temporary and permanent facilities shall be removed and properly disposed of and the area restored.

### 3.02 EROSION MAT

- A. Erosion mats shall be installed in accordance with manufacturer’s requirements and with Conservation Practices Standards 1052 and 1053.

- B. Place erosion mats immediately after seeding operations have been completed. Before mat placement, remove all material or clods over 1-1/2 inches in diameter and all organic material or other foreign material which may interfere with the mat bearing completely on the soil.
- C. Any small stones or clods which prevent contact of the mat with the soil shall be pressed in the soil with a small lawn-type roller or by other means. The mat shall have its lateral edge so impressed in the soil so as to permit runoff water to flow over it.
- D. The matting strips shall be rolled on or laid in direction of flow. Spread mat evenly and smoothly in a natural position without stretching and with all parts bearing on soil. Place blanket with netting on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. Make overlaps with upgrade section on top.
- E. Bury upgrade end of each strip of fabric or blanket at least 6 inches in a vertical slot cut in the soil and press soil firmly against the imbedded fabric or blanket.
- F. Anchor mats in place with vertically driven staples, driven until their tops are flush with the soil. Space staples on 3-foot centers along mat edges and stagger space at 3-foot centers through the center. Place staples at 10-inch centers at end or junction slots.
- G. Reseed areas damaged or destroyed during erosion mat placing operations as specified for original seeding.
- H. Dispose of surplus excavated materials during erosion mat placing operation as specified for original seeding.
- I. Following mat placement, uniformly apply water to the area to moisten seed bed to 2-inch depth and in a manner to avoid erosion.
- J. Maintain erosion mat and make satisfactory repairs of damage from erosion, traffic, fires, or other causes until Work is accepted.

### 3.03 SILT FENCE

- A. Silt fence shall be constructed in conformance with the criteria specified in Conservation Practice Standard 1056–Silt Fence.

### 3.04 SOIL STABILIZER

- A. Soil Stabilizer Type A shall be applied with conventional hydraulic seeding equipment. CONTRACTOR shall take care to ensure that surrounding surfaces, structures, trees, and shrubs are not over-sprayed. Before Work is accepted any over-spray must be satisfactorily cleaned from surfaces. The finished application shall be 3/16-inch to 1/4-inch thick. For permanent slope applications, CONTRACTOR shall sow seed separately before applying the soil stabilizer to ensure that the seed has direct contact with the soil.
- B. Soil Stabilizer Type B shall be applied with conventional hydraulic seeding equipment or by dry spreading. CONTRACTOR shall apply material at the manufacturer's recommended rate. For permanent slope applications, CONTRACTOR shall apply an approved mulch when the soil stabilizer is applied or after it is applied to protect the seed.

### 3.05 INLET PROTECTION

- A. All storm drains that are or will be functioning during construction shall be provided with inlet protection. Inlet protection shall be provided in conformance with the criteria specified in Conservation Practice Standard 1060–Storm Drain Inlet Protection for Construction Sites.

### 3.06 STONE TRACKING PADS AND TIRE WASHING

- A. Tracking pads (tire washing stations as required) shall be installed in accordance with the criteria in Conservation Practice Standard 1057–Stone Tracking Pad and Tire Washing.
- B. Surface water must be prevented from passing through tracking pads. Flows shall be diverted away from tracking pads and conveyed under and around them such as with culverts.
- C. Any sediment tracked onto a road shall be removed before the end of each day. Flushing sediment shall not be allowed.

### 3.07 SEEDING FOR EROSION CONTROL

- A. Temporary seeding for erosion control shall be provided in conformance with the criteria specified in Conservation Practice Standard 1059–Seeding for Construction Site Erosion Control.

### 3.08 SEDIMENT TRAPS AND SEDIMENT BASINS

- A. Sediment traps for erosion and sedimentation control during interim construction stages shall be installed in accordance with the criteria in Conservation Practice Standard 1063–Sediment Trap and sediment basins with the criteria in 1064–Sediment Basin. They shall be constructed prior to any disturbances and shall be placed so they function during all phases of the Work.

END OF SECTION

## SECTION 02510

### HOT MIX ASPHALT PAVING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes Hot Mix Asphalt (HMA) paving, tack coat, and casting adjustments.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. 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 02231–Aggregate Base Course.
- D. Payment for HMA paving shall be considered incidental to the project and included in the lump sum bid.

##### 1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.

##### 1.03 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, and parking lots.

##### 1.04 SUBMITTALS

- A. Prior to the commencement of paving, mix designs and aggregate sieve analysis shall be submitted to ENGINEER for approval in accordance with Section 01300–Submittals.

#### PART 2–PRODUCTS

##### 2.01 HMA PAVEMENT

- A. Asphaltic pavement shall be HMA Pavement Type E-0.3. Asphaltic material for lower layer and upper layer shall be asphaltic material PG58-28.
- B. Aggregate shall conform to the requirements of Section 460.2.2 of the Standard Specifications. Aggregate for the lower layer shall be nominal size of 19.0 mm. Aggregate for the upper layer shall be nominal size of 12.5 mm.

- C. Where existing pavement is replaced, minimum pavement thickness shall be 4 inches or existing thickness, whichever is greater. Lower layer shall be 2-1/4 inches minimum. Upper layer shall be 1-3/4 inches minimum.
- D. Materials for tack coat shall conform to the requirements of Section 455.2.5 and shall be MS-2, SS-1, SS-1h, CSS-1 or CSS-1h.
- E. Pavement markings shall conform to Section 646 for white markings, except without the reflective additive.

## PART 3-EXECUTION

### 3.01 ALLOWABLE REMOVAL OF PAVEMENT

- A. CONTRACTOR shall remove asphalt pavement and road surface as a part of the general excavation. The width of pavement removed shall be the minimum possible and acceptable for convenient and safe installation of structures, utilities, and appurtenances.
- B. All asphalt pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the excavation. Should the cut edge be damaged, a new cut shall be made in neat, straight lines parallel to the original cut encompassing all damaged areas. Pavement removal shall be extended to a seam or joint if seam or joint is within 3 feet of damaged pavement.

### 3.02 CASTING ADJUSTMENTS

- A. All new and existing manhole castings and valve boxes within the paving limits of the street, which require adjustment, shall be adjusted to match the finished asphaltic surface. Adjustments shall not be made greater than 48 hours prior to the anticipated time of paving. Adjustments shall be performed as called for in Section 02600-Buried Piping and Appurtenances. CONTRACTOR shall furnish Class 1 barricades with flashers on all adjusted castings until paving has been completed. Tops of castings and valve boxes shall be oiled or protected by other methods to prevent sealing of lids and filling of lift holes during paving. Upon completion of paving operations, CONTRACTOR shall check all castings and valve boxes to insure that the lids are clean and operational. Manhole casting adjustment shall be included in the cost of other items of work, and no further compensation will be made. Valve box adjustment shall be considered an incidental item of work.

### 3.03 TACK COAT

- A. All work shall be in accordance with the Standard Specifications.
- B. If asphaltic upper layer is applied to an existing street or is not applied the same day as lower layer, the existing street or lower layer shall be tack coated prior to surface paving. Prior to placement of tack coat, the streets shall be thoroughly cleaned and broomed. Tack coat shall be applied at a rate of 0.10 gallons per square yard immediately prior to placement of asphaltic upper layer.
- C. In situations where traffic must be maintained, tack coat shall not be placed on the traveled half of the street until traffic can be switched to the new pavement.

### 3.04 JOINTS

- A. Joints between old and new pavements or between successive day's work shall be constructed and treated as to insure thorough and continuous bond between the old and new mixtures. Transverse construction joints shall be constructed by cutting the material back for its full depth so as to expose the full depth of the course. Where a header is used, the cutting may be omitted provided the joint conforms to the specified thickness. These joints shall be treated with tack coat material applied with a hose and spray nozzle attachment to fully coat the joint surface.
- B. The longitudinal joint shall be made by overlapping the screed on the previously laid material for a width of not more than 2 inches and depositing a sufficient amount of asphaltic mixture so that the finished joint will be smooth and tight. Longitudinal joints in the upper layer shall at no time be placed immediately over similar joints in the lower layer beneath. A minimum distance of 12 inches shall be permitted between the location of the joints in the lower layer and the location of similar joints in the upper layer above.
- C. All costs for furnishing and applying tack coat to butt joints as specified above shall be considered incidental.

### 3.05 FINISHING ROADWAY

- A. The finished base course shall be fine-graded in preparation for HMA paving. Base course ramps at all existing pavement shall be removed to provide a full depth butt joint. Base course around manhole castings and valve boxes shall be hand-trimmed and compacted with a vibratory plate compactor.
- B. This item shall include all of the following preparatory and finishing items and any other incidental items of work required for construction. Asphaltic ramps around manholes on existing lower layer to receive upper layer shall be removed. Asphaltic ramps shall be installed on all manholes and at all butt joints in areas to receive lower layer only.
- C. Finishing roadway shall be considered incidental to HMA paving.
- D. Paint all markings as shown on drawings with lines not less than 4 inches wide.

### 3.06 TESTING HOT MIX ASPHALT

- A. ENGINEER may require samples of HMA pavement for testing. CONTRACTOR shall cut samples from the finished pavement where marked by ENGINEER and patch the sample area. Samples for sieve analysis and asphalt content will be taken by ENGINEER prior to placement.

### 3.07 HOT MIX ASPHALT PAVING

- A. HMA paving work shall include the construction of plant-mixed hot mix asphalt pavement in the areas shown on the drawings. All work shall be performed in accordance with Section 460 of the Standard Specifications.
- B. Prior to commencement of paving operations, CONTRACTOR shall examine the finished road bed. CONTRACTOR shall notify ENGINEER of any areas of suspected instability.

- C. The pavement structure for new roads shall be determined from the standard cross sections provided on the drawings.

END OF SECTION

## SECTION 02600

### BURIED PIPING AND APPURTENANCES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All underground piping and valves of every description.
  - 2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
  - 3. Concrete reaction blocking, gaskets, and all miscellaneous equipment furnished under this section.
  - 4. Underground piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 1 and the City of Madison Standard Specifications 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 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. All materials shall be National Sanitation Foundation (NSF)-approved.
- 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 standard 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 selected by CONTRACTOR and submitted for review by ENGINEER.

##### 2.02 BURIED PIPING

- A. Ductile Iron Piping and Fittings:
  - 1. Unless otherwise specified, all exterior piping shall conform to AWWA C151 with wall thickness provided in accordance with AWWA C150 for the depth of cover shown on the drawings using a minimum rated working pressure of 350 psi and Laying Condition 4; minimum Special Class 52, unless otherwise shown or specified. The words “ductile iron,” weight and class of pipe shall be plainly marked on each piece of exterior pipe.

2. Except where shown, exterior pipe joints shall be mechanical joint or push-on joint. All mechanical and push-on joints shall be bonded with cable bond conductors or electrobond conductivity strips.
  3. Exterior joints and gaskets shall conform to AWWA C110 and C111.
  4. Bolts on exterior joints shall be high-strength low-alloy steel (Corten, or equal) conforming to AWWA C111. Certificate to that effect shall be provided.
  5. Except where shown otherwise, exterior fittings shall be mechanical joint or push-on joint. Exterior fittings and gaskets shall comply with AWWA C110, Ductile Iron Fittings, or C153, Ductile Iron Compact Fittings, and C111, as applicable, with a minimum rated working pressure of 150 psi.
  6. Exterior and/or buried pipe and fittings shall be cement-mortar lined and asphaltic coated inside and asphaltic coated outside. Cement-mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
- B. Copper Piping: All buried copper piping shall be provided as specified in Section 15040-Piping and Accessories.
- C. Gas Piping:
1. All natural gas piping shall be provided in accordance with all state, local, and utility codes pertaining to natural gas service or service requirements.
  2. All underground natural gas piping shall be DriscoPlex 6500 yellow polyethylene pipe for gas service, or equal. Pipe material shall be PE 2708 (PE 2406) medium density polyethylene meeting cell classification 234373E in accordance with ASTM D3350. Pipe shall be tested in accordance with ASTM D2513. Pipe shall have a minimum SDR of 11.0. Pipe shall have a minimum burial depth of 3.0 feet. Joints shall be fusion-welded in accordance with manufacturer's recommendation. All fittings shall be rated for gas service. All entrances to building shall be above grade and use a riser pipe connection to below grade structures with transition fitting from PE pipe to steel pipe. Steel section shall be epoxy-coated with threaded end.
  3. Provide tracer wire as specified.
- D. Drainage Piping: All buried drainage piping including waste, soil, and vent piping shall be provided as specified in Section 15040-Piping and Accessories.

## 2.03 VALVES

- A. Valves: Valves and accessories for underground service are specified in the City of Madison Standard Specifications.

## 2.04 FIRE HYDRANT

- A. Fire Hydrant:
1. Fire hydrant and accessories are specified in the City of Madison Standard Specifications.
  2. Provide restrained joint system from auxiliary valve in road box back to tee.
  3. Connect hydrant to auxiliary valve with 2-foot length of pipe. Auxiliary valve shall be gate valve with cast iron road box as specified in the City of Madison Standard Specifications.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. All buried ductile iron piping and appurtenances shall be polyethylene encased in accordance with AWWA C105. Polyethylene encasement shall be minimum 8 mil thickness. Repair any rips or punctures prior to backfilling pipe.
- B. Installation Standards:
1. Except where noted or specified, all underground water main piping shall be laid in accordance with AWWA C600 with all sewer clearances and separations from water main in accordance with Wisconsin Department of Natural Resources requirements.
  2. Gas piping shall be installed in accordance with state and local codes and the National Fuel Gas Code, NFPA No. 54.
  3. Plumbing system shall be installed in accordance with applicable portions of the Plumbing Code. Where requirements conflict, the stricter standard shall apply.
  4. When PVC 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 as required.
- C. General Excavation:
1. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this contract, unless otherwise noted.
  2. Work shall conform to other sections of Division 2 except where modified by this section.
  3. 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.
  4. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used as necessary.
  5. If the maximum trench width is exceeded for any reason other than by request of ENGINEER, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense.
  6. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill, and rock excavation, the removal of pavement, and all incidental work thereto. All above work shall be included in the Lump Sum Bid.
  7. 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.
  8. 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 with material and placing methods as specified in Section 02222–Excavating, Backfilling and Compaction.
  9. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable.
  10. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work.
  11. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service.
  12. The present underground services shown on the drawings are located in accordance with available data.

13. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
14. Any service connections encountered which are to be removed shall be cut off at the limits of the excavation and capped in accordance with the requirements of owners of such connections.
15. Excavated material that is unsuitable or not required for filling shall be wasted.
16. 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.
17. 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.

D. Laying Pipe:

1. CONTRACTOR shall excavate and lay all pipe to the line and grade shown on the drawings with bell ends uphill.
2. Grade stakes will be required for all lines.
3. Water lines shall have a minimum of 6 feet of cover unless noted otherwise.
4. Unless shown otherwise, under floor piping shall clear floor slabs or footings by a minimum of 6 inches.
5. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used.
6. Pipe must be kept clean of mortar, cement, clay, sand or other material.
7. Trenches shall be kept water-free and dry during bedding, laying, and jointing.
8. 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.
9. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.

E. Restraint Based on Concrete Thrust Blocking:

1. Except where noted or indicated, all bends, caps, plugs, tees, and other fittings shall be anchored with poured concrete to resist thrust as shown on Figure 01-975-92A included at the end of this section. The thrust block sizes are based on assumed minimum soil bearing pressures of 4,000 lbs/ft<sup>2</sup>.
2. If CONTRACTOR determines soil bearing pressure is under 4,000 lb/ft<sup>2</sup> or if adequate support against undisturbed soil cannot be obtained, CONTRACTOR shall provide proportionally larger thrust blocks or shall provide tie rods or restraining joints.
3. Where indicated as a "restrained" joint or where use of concrete thrust block is not possible, mechanical joints on ductile iron pipe shall be restrained by MEGALUG<sup>®</sup> 1100 or 1100SD Series by EBAA Iron Sales, Inc. or equal restraining system.
4. Where indicated as a "restrained" joint or where use of concrete thrust block is not possible, ductile iron push-on joint pipe shall be restrained by Lok-Ring Joint by American Ductile Iron Pipe, TRFLEX by U.S. Pipe, MEGALUG<sup>®</sup>1100HD Series by EBAA Iron Sales, Inc., or equal.
5. Push-on joints for PVC piping shall be restrained with MEGALUG<sup>®</sup> Series 1500 (AWWA C900) or Series 2800 (AWWA C905) by EBAA Iron Sales, Inc., UNIFLANGE SERIES 1350 by Ford Meter Box Co., Inc., or equal. PVC piping with ductile iron

mechanical joint fittings shall be restrained with MEGALUG® Series 2000 PV by EBBA Iron Sales Inc., UNIFLANGE Series 1500 by Ford Meter Box Co., Inc., or equal.

6. If flexible restraint system used in lieu of concrete reaction blocking, submit to ENGINEER calculations determining the minimum number of restrained joints on both sides of fitting required to restrain pipe.

F. Bedding:

1. All underground pipe, except copper, and polyethylene encased pipe, shall be bedded in compacted granular material.
2. Copper and polyethylene encased pipe piping shall be bedded in compacted sand.
3. Ductile iron piping shall be placed using Class "C" Bedding Details as shown on Drawing No. 01-975-43A.
4. All other piping, except perforated piping and ductile iron piping, shall be placed using Class "B" Bedding Details as shown on Drawing No. 01-975-43A.
5. CONTRACTOR shall perform all necessary excavation and shall furnish all required materials to provide bedding material. Bedding material shall conform to the gradation requirements of ASTM C-33.
6. Bedding material shall be hard, tough, and durable and shall meet the following gradation requirements:

PERCENTAGE BY WEIGHT PASSING

	Crushed Stone Aggregate	Crushed Stone Chips	Crushed Gravel Aggregate	Bedding Sand
1-inch	100	--	100	--
3/4-inch	90 to 100	--	90 to 100	--
1/2-inch	--	100	--	--
3/8-inch	20 to 55	90 to 100	20 to 55	100
No. 4	0 to 10	--	0 to 10	95 to 100
No. 8	0 to 5	0 to 15	0 to 5	80 to 100
No. 30	--	0 to 5	--	25 to 60
No. 100	--	--	--	5 to 20
Passing No. 200	--	--	--	2 to 10

7. CONTRACTOR shall furnish ENGINEER with a sieve analysis of the bedding material for approval prior to construction.
8. No materials native to the trench shall be used as bedding material unless they meet the above specifications.
9. Native material may be used for ductile iron piping if it consists mostly of sand and contains no stones larger than 3/4 inch.
10. Immediately prior to placing the pipe, bedding shall be shaped by hand to fit the entire bottom quadrant of the pipe between bell holes.
11. Bell holes shall be large enough to permit proper making of the joint but not larger than necessary to make the joint.
12. All adjustments to line and grade must be done by scraping away or filling in bedding under the body of the pipe. Bedding must be tamped into place.
13. If necessary to obtain uniform contact of the pipe with the bedding, a template shall be used.

- G. Cover Material:
1. Material which is to be placed from the bedding material around and to 1 foot above the top of all pipe shall be termed cover material.
  2. Except for copper piping, cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination.
  3. Unwashed bank run sand and crushed bank run gravel will be considered generally acceptable for cover material.
  4. No stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material.
  5. Native materials may be used if they conform to the above specifications.
  6. Cover material for copper piping shall be sand.
  7. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously.
  8. Granular cover material shall be placed over the top of the pipe to the height as shown on Drawing 01-975-43A for Class "B" (12 inches) or Class "C" (6 inches) Bedding.
  9. This cover material shall be placed by hand in 6-inch layers and shall be compacted using hand-tamping bars and/or mechanical tampers.
  10. If bedding material, except sand, conforming to any of the above three gradations under "Bedding" is used as cover material, it need not be tamped.
  11. Sand cover material must be tamped.
  12. Unless sand backfill is required, the remaining 6 inches to make up the required 1 foot of cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4 inch.
  13. Compaction shall be equivalent to that described under "Filling and Backfilling" in these specifications.
- H. Backfill: Except as otherwise specified, all backfill above 1 foot above the pipe shall be granular material specified in Section 02222–Excavation, Fill, Backfill and Grading. Compaction shall be as specified herein.

### 3.02 REPAIR/RESTORATION

- A. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced, including all site improvements, landscaping, and/or paving material as existed prior to construction.

### 3.03 FIELD QUALITY CONTROL

- A. Site Tests:
1. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price bid.
  2. All piping shall be subject to test before being covered with base course or pavement. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
  3. All piping and appurtenances shall be flushed or cleaned after installation prior to testing.
  4. When test medium for piping is water, all air shall be removed from piping by flushing and/or installation of corporations at high points in system. Presence or absence of air will be determined during pressurization of the piping system.
  5. 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. Note, when pressure testing against existing valves or piping, CONTRACTOR shall assume these items will fail and provide temporary plugging or valving as required.

6. Pressure Tests: The test pressure in all nongravity 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.
7. Leakage allowance shall be not more than 0.002 gallon per hour per inch diameter per 100 feet of buried pipe for compression or solder joint pipe. Buried mechanical and push-on joint pipe shall meet the leakage specifications of AWWA C600.
8. Tests for all gravity sewers shall be as follows: Pipe will be plugged at its downstream end and water will be placed inside the pipe to a minimum head of 10 feet. Water shall be held for 15 minutes without dropping. No leakage is allowed.

### 3.04 CLEANING AND DISINFECTION

- A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the system before it is put on line. Water main, including buried and exposed piping, shall be disinfected according to AWWA C651 and City of Madison Standard Specifications. See the City of Madison Standard Specifications regarding main flushing and disinfection.
- B. In accordance with the requirements of AWWA C651-05, at least one set of samples shall be collected from every 1,200 feet of new water main, plus one set from the end of the line and at least one set from each branch.
- C. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Bid. Copies of test results shall be submitted to OWNER and ENGINEER.
- D. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- E. All waste disposal areas and all areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off, cleaned up, and returned to condition that existed prior to construction.
- F. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.

END OF SECTION

## SECTION 02831

### VEHICLE GATE

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes providing a vehicle gate as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM F567–Installation of Chain-Link Fence.
- B. ASTM F900–Industrial and Commercial Swing Gates.
- C. ASTM F1043–Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
- D. Chain Link Fence Manufacturers' Institute (CLFMI)–Product Manual.

#### PART 2–PRODUCTS

##### 2.01 VEHICLE GATE

- A. Vehicle gate shall be as manufactured by Hoover Fence Co., [www.hooverfence.com](http://www.hooverfence.com), 1-800-335-2335, or equal. Provide a 4-foot-high by 26-foot-wide Double Aluminum S-Series Tubular Barrier Gate.
- B. Gate shall include the following and any accessories to provide a complete system.
  - 1. Aluminum double tubular barrier gate.
  - 2. Aluminum post caps for gate and hinge posts.
  - 3. Aluminum Schedule 40 gate hinge posts.
  - 4. Aluminum butt hinges.
  - 5. Aluminum strong arm double gate latch with padlock provisions.
  - 6. No dig gate hold backs attached to gate posts to hold gate in open position.

##### 2.02 CONCRETE

- A. Concrete shall be Type A or A-FA as specified in Section 03300–Cast-in-Place Concrete.

## PART 3–EXECUTION

### 3.01 CONCRETE FOOTINGS

- A. Excavate holes for footings to neat dimensions in firm ground to insure the post will be centered. Remove rock or other obstructions encountered to the required depth. Use forms in unstable soil, and allow them to remain in place for at least 24 hours after concrete is poured. Backfill, after forms are removed, with suitable material thoroughly compacted in place in layers to prevent settlement.
- B. Footings shall be 42 inches deep and 12 inch minimum diameter. The bottom of the post shall be 3 inches above the bottom of the hole. Concrete bases shall be domed at the post and have a smooth troweled finish. Concrete footings shall cure for seven days before placing load on them.

### 3.02 GATES

- A. Install gates plumb and level and adjust for smooth operation as intended without binding or hanging up.

### 3.03 CLEANUP

- A. After gate construction is completed, clean up all storage and work areas. Replace or repair, as required, all landscape features damaged or disturbed under this Contract.

END OF SECTION

## SECTION 02936

### SEEDING AND SODDING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Preparation of subsoil.
  - 2. Placing topsoil.
  - 3. Seeding, sodding, mulching and fertilizing.
  - 4. Maintenance.
- B. Except for paved, riprapped, or built-up areas, all areas of the site which are disturbed and areas noted on the drawings shall be seeded. Surfaces on 3 to 1 slope or less may either be seeded or sodded but surfaces on greater than 3 to 1 slope shall be sodded.
- C. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. FS O-F-241–Fertilizers, Mixed, Commercial.
- B. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure, current edition, including all issued supplemental specifications.

##### 1.03 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Sod: Minimum age of 18 months, with root development that will support its own weight without tearing when suspended vertically by holding the upper two corners. Submit sod certification for grass species and location of sod source.

##### 1.04 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver sod on pallets or in rolls. Protect exposed roots from dehydration. Do not deliver more sod than can be laid within 24 hours.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

## PART 2–PRODUCTS

### 2.01 SEED MIXTURE

- A. Seed mix No. 40 according to Standard Specifications. Use blue tag certified seed. DO NOT use bent or Poa Annua. Each seed lot will be subject to sampling and testing by the state seed laboratory.
- B. Weed content shall not exceed 0.5% in mixture.

### 2.02 SOD

- A. Follow Section 631.1.2.1 of the Standard Specifications.
- B. Netting or fabric for sod reinforcement shall be in accordance with Section 631.2.2 of the Standard Specifications.
- C. Anchorage staples shall be in accordance with Section 631.12.3 of the Standard Specifications.

### 2.03 SOIL MATERIALS

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay, or impurities, plants, weeds, roots and rocks; pH value of minimum 5.4 and maximum 7.0.
- B. Topsoil from the site may be used if it meets the above requirements. Additional topsoil shall be provided as required by drawings and specifications.

### 2.04 ACCESSORIES

- A. Mulching material shall be oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Fertilizer shall be FS O-F-241, Type I, Grade A; recommended for grass, with 50% of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil to the following proportions: Nitrogen 10%, phosphoric acid 10%, soluble potash 10%. Submit composition deviations to suit site conditions for ENGINEER's approval.
- C. Water shall be clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

## PART 3–EXECUTION

### 3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

### 3.02 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated subsoil in accordance with local, state, and federal regulations.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

### 3.03 PLACING TOPSOIL

- A. Spread topsoil to a minimum depth of 4 inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign nonorganic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Manually spread topsoil around trees, plants, and buildings to prevent damage.
- F. Leave stockpile area and site clean and raked, ready to receive landscaping.

### 3.04 FERTILIZING

- A. Apply fertilizer at a rate of 17 pounds per 1,000 square feet.
- B. Apply after smooth raking of topsoil and prior to installation of seed or sod, no more than 18 hours before seeding or 48 hours before sodding.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

### 3.05 SEEDING

- A. Apply seed at a total rate of 3-1/2 pounds per 1,000 square feet. Apply evenly in two intersecting directions. Rake in lightly or roll the seeded area after seeding.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting season shall be between April 15 and June 15 or between August 15 and October 15.
- D. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- E. Immediately following seeding, apply mulch.
  - 1. Minimum Spread Rate: 1-1/2 tons per acre.

2. Maximum Depth: 1-1/2 inches to 2 inches.

- F. Apply water with a fine spray immediately after each area has been mulched and on a daily basis to keep straw in place.
- G. Seeding 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.
- H. Place erosion control mats per Section 02270–Slope Protection and Erosion Control.

### 3.06 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod immediately after delivery to site to prevent deterioration.
- C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Lay smooth. Align with adjoining grass areas.
- E. Place top elevation of sod 1/2-inch below adjoining edging, paving, or curbs.
- F. On slopes 4 to 1 and steeper, sod will be secured with wooden pegs at a maximum of 24 inches on center.
- G. On slopes 2 to 1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- H. All sod placed in ditches, flumes, or other appurtenances where a concentrated flow of water may be expected shall be staked regardless of the slope.
- I. Water sodded areas immediately after installation. Saturate sod to 4-inch depth of soil.

### 3.07 MAINTENANCE

- A. Water to prevent grass and soil from drying out.
- B. Roll surface to remove minor depressions or irregularities.
- C. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- D. 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. Immediately replace sod in areas which show bare spots or deterioration.
- E. Protect seeded areas with warning signs during maintenance period.
- F. Immediately reseed areas which do not show a satisfactory stand of established grass, and resod areas that do not show satisfactory establishment.

- G. Correct damage resulting from erosion, gullies, rills, or other causes by filling with topsoil, tamping, refertilizing, and reseeding if damage occurs prior to acceptance of work.
- H. Maintain seeded lawns for not less than 60 days after substantial completion.
- I. If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.
- J. Maintain sodded lawns for not less than 30 days after substantial completion.
- K. Maintain lawns by watering, fertilizing, weeding, and other operations such as rolling, regrading, and replanting as required to establish a smooth acceptable lawn free of eroded or bare areas.

END OF SECTION

## SECTION 02950

### TREES, PLANTS, STONE MULCH, AND EDGING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Trees and plants.
  - 2. Stone mulch.
  - 3. Plastic and aluminum edging.
  - 4. Maintenance.
  - 5. Tree Pruning.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years experience. Plant materials shall be free of disease and hazardous insects.
- B. Installer Qualifications: Company specializing in installing and planting the plants with three years experience.
- C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.

##### 1.03 WARRANTY

- A. All plant material is to be fully guaranteed for a period of one year from the date of final completion. Only those plants that are alive and normally healthy for the first year will be accepted. Unaccepted material shall be removed and replaced by CONTRACTOR at no cost to OWNER during the next suitable growing season.
- B. Replacement plants shall be the same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

#### PART 2–PRODUCTS

##### 2.01 PLANT MATERIALS

- A. All plant materials shall conform to American Standard for Nursery Stock (current edition). Plants shall be true to species and variety specified and nursery grown in accordance with good horticultural practices.
- B. Plant Materials: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the project for at least two years.

- C. Trees with multiple leaders, unless specified, will be rejected. Trees with a damaged, cut, or crooked leader, included bark, abrasion of bark, sunscald, disfiguring knots, insect damage, mold, or prematurely opened buds are cause for rejection.

## 2.02 MULCH MATERIALS

- A. Stone Mulch: Stone mulch shall be 3/4-inch crushed stone.

## 2.03 ACCESSORIES

- A. Edging: Commercial edging by COL-MET, or equal. Metal edging shall be Commercial grade 1/8-inch by 4 inches.
- B. Membrane: 20 mil thick, water permeable polyolefin fabric.
- C. Wrapping Materials: Burlap or other commercial grade tree wrap.
- D. Stakes: Softwood lumber, pointed end or mild steel angle, galvanized, pointed end.
- E. Cable, Wire, Eye Bolts: Noncorrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.
- F. Tree Protectors: Rubber sleeves over cable to protect tree stems, trunks, and branches.

## PART 3—EXECUTION

### 3.01 PLANTING

- A. Plant pits shall be excavated with vertical sides. These holes shall be no deeper than the depth of the ball, container, or root system when the plant is at its proper grade. Set plants vertical.
- B. Place topsoil in holes around roots or balls, mixed with fertilizer and peat moss or compost. Topsoil around roots shall be compacted and watered. After plant pit is backfilled, shallow basin shall be formed with ridge of soil to facilitate watering.
- C. Place plants where indicated on the drawings. Position plants for best appearance.
- D. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.
- E. Remove nonbiodegradable root containers and twine.

### 3.02 TREE REMOVAL AND REPLACEMENT

- A. Trees marked for removal within street and road rights-of-way and in easements shall be removed by CONTRACTOR and properly disposed. Trees within street and road rights-of-way marked for removal need not be replaced unless specifically noted otherwise on drawing. CONTRACTOR shall replace all other removed and damaged trees and shrubs with new stock at its expense. New trees shall be located as requested by OWNER or ENGINEER.

- B. Trees shall be replaced as follows. Diameters shall be measured 4 feet above the ground.

Deciduous Trees

Up to 1 1/2 inches	Like size and type
Greater than 1 1/2 inches	Min. 1 1/2-inch of like type

Coniferous Trees

Up to 6 feet tall	Like size and type
Greater than 6 feet tall	Min. 6-foot tree of like type

- C. All bushes and shrubs removed during construction shall also be restored to their original position and condition. If the bush or shrub is damaged or dies after restoring, CONTRACTOR shall replace it with one of same kind and size up to a height of 4 feet. Bushes and shrubs beyond this height shall be replaced by one 4 feet.
- D. It is intended that as many trees as possible be saved during construction. No trees, except those so designated, shall be removed without prior approval. CONTRACTOR shall conduct the work to protect all trees to remain. CONTRACTOR shall provide suitable fencing installed at the tree drop line for all trees within the construction area to protect trees from damage and soil compaction by its equipment.
- E. Trees which are damaged during construction shall be repaired. CONTRACTOR shall retain the services of a professional nurseryman who is a member of the National Arborist Association to direct them on the proper repair of damaged trees. Damaged limbs and roots shall be pruned or dressed according to recommendations of the nurseryman. Backfill shall be replaced as soon as possible to reduce exposure of roots to air. Scarfed areas on trees shall be suitably dressed. Compaction of root areas under the drip line of the tree is to be avoided whenever possible.
- F. When removing trees, special care shall be taken so as not to damage surrounding private property. Tree removal method shall be reviewed by ENGINEER and approved by OWNER. Costs for tree removal or replacement and construction around trees shall be included in the price bid for the work.
- G. CONTRACTOR shall relocate, or bore and jack under or by such trees as desired to minimize construction damage. Cost for such construction shall be included in the price bid for the work.

3.03 INSTALLATION OF ACCESSORIES

- A. Place edging around planting areas where shown on the drawings. Install edging using stakes at approximately 4 feet on center.
- B. Place membrane (weed barrier) in all areas to receive stone or hardwood mulch.
- C. Wrap deciduous shade and flowering tree trunks and place tree protectors.

3.04 PLANT SUPPORT

- A. Brace plants vertically with plant protector wrapped guy wires and stakes to the following:

Tree Caliper	Tree Support Method
1-inch	1 stake with one tie
1 to 2 inches	2 stakes with two ties
2 to 4 inches	3 guy wires
Over 4 inches	4 guy wires

3.05 TREE PRUNING

- A. Each tree and shrub shall be pruned in accordance with good horticulture practice to preserve natural character of plant and to facilitate growth.

3.06 MULCH

- A. Place stone mulch to 3-inch depth over membrane in all areas indicated on the drawings.

3.07 MAINTENANCE

- A. Maintain plant life for three months after date of substantial completion.
- B. Neatly trim plants where necessary.
- C. Immediately remove clippings after trimming.
- D. Water to prevent soil from drying out.
- E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.
- F. Apply pesticides in accordance with manufacturer's instructions.

3.08 SCHEDULE-PLANT LIST

- A. See drawings for schedule.

END OF SECTION

SECTION 03100  
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 1 shall govern work in this section.

1.02 REFERENCES

- A. ACI 301–Structural Concrete for Buildings.
- B. ACI 318–Building Code Requirements for Reinforced Concrete.
- C. ACI 347–Recommended Practice for Concrete Formwork.
- D. 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 01300–Submittals for form ties, form coatings, form liners (if any), and any other form accessories.
- B. Submit geometry of forms for circular structures.

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 a neoprene plug, Dayton Superior, Inc., Sure-Plug, or equal.
- C. Cementitious waterproofing for patching taper tie holes shall be Hey Di K-11, Xypex Patch-N-Plug, or equal.

#### 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 and insure safety to workmen and passersby. Spacing of ties shall be recommended by the tie manufacturer.
- B. Formwork shall be constructed to meet the tolerances and intentions specified below for the indicated applications:
  - 1. Flat surfaces shall be formed in accordance with tolerances indicated in ACI 347 for buildings.
  - 2. Curved surfaces shall also meet ACI 347 for buildings. All exposed curved surfaces shall be formed to the continuous surface of the radius specified. Where segmented forms are proposed, a form system which deviates more than 3/8-inch from a circle through pan edges will not be allowed.
  - 3. 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.
  - 4. Variation from plumb shall not exceed 1/4-inch in 10 feet, and variation in linear lines shall not exceed 1/2-inch in 20 feet. These and other tolerance specified in ACI-347 shall be considered a part of this specification.
- C. 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.
- D. 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.
- E. 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.
- F. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.
- G. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to assure 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.
- H. 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.

- I. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to the approval 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 and will ensure complete safety of the structure.
- C. Forms shall not be removed before the expiration of the minimum times as stated below unless specifically authorized by ENGINEER. These times may be increased by ENGINEER.
  1. Wall and vertical faces: 24 hours
  2. Columns: 24 hours
  3. Beams and slabs: 14 days

END OF SECTION

## SECTION 03200

### CONCRETE REINFORCEMENT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 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 A82—Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement.
  - 4. ASTM A185—Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.
  - 5. ASTM A615—Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 6. CRSI—Manual of Standard Practice.
  - 7. ASTM C1116—Standard Specification for Fiber-Reinforced Concrete.

##### 1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01300—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, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.
- B. Steel wire shall comply with ASTM A82.
- C. Welded wire fabric shall comply with ASTM A185. Fabric shall be provided in flat sheets. Rolled fabric shall not be used.
- D. 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.
- E. Fibrous Reinforcing:
  - 1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Propex Concrete Systems, or equal.
  - 2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.
  - 3. Physical Characteristics:
    - a. Specific Gravity: 0.91.
    - b. Fiber Length: Multidesign gradation.

### 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 as approved by 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 #4 at 8-inch centers each way in members 10 inches or less in thickness and #5 at 12-inch centers each way in each face in members greater than 10 inches thick.
- H. Fibrous Reinforcing:
1. Fibrous concrete reinforcing shall be used in all slab-on-grade concrete and all precast concrete topping.
  2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
  3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION

## SECTION 03300

### 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, and other related items and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ACI 211.1–Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301–Structural Concrete for Buildings.
- C. ACI 304–Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R–Hot Weather Concreting.
- E. ACI 306R–Cold Weather Concreting.
- F. ACI 308–Standard Practice for Curing Concrete.
- G. ACI 309–Guide for Consolidation of Concrete.
- H. ACI 318–Building Code Requirements for Reinforced Concrete.
- I. ASTM C31–Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33–Concrete Aggregates.
- K. ASTM C39–Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C40–Organic Impurities in Fine Aggregates for Concrete.
- M. ASTM C94–Ready-Mixed Concrete.
- N. ASTM C143–Slump of Portland Cement Concrete.
- O. ASTM C150–Portland Cement.
- P. ASTM C172–Standard Practice for Sampling Freshly Mixed Concrete.
- Q. ASTM C156–Test for Water Retention by Concrete Curing Materials.

- R. ASTM C231–Air Content of Freshly Mixed Concrete by the Pressure Method.
- S. ASTM C260–Air-Entraining Admixtures for Concrete.
- T. ASTM C309–Liquid Membrane Forming Compounds for Curing Concrete.
- U. ASTM C494–Chemical Admixtures for Concrete.
- V. ASTM C618–Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- W. ASTM D994–Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- X. ASTM D1752–Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

### 1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300–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. All cement used shall be Portland Cement and shall conform to ASTM C150 and shall be Type I or Type III. Type III 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, weather-tight, 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 percent of the weight of the aggregate.
- C. If required by ENGINEER, sodium sulfate soundness tests (ASTM Designation 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 Designation 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
Passing 2-inch sieve	---
Passing 1-1/2 inch sieve	---
Passing 1-inch sieve	100
Passing 3/4-inch sieve	90-100
Passing 3/8-inch sieve	20-55
Passing No. 4 sieve	0-10
Passing No. 8 sieve	0-5

- H. 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 Pozzolith 200N by BASF Admixtures, Inc., 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 MB AE90 Standard by BASF Admixtures, Inc., 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 which can be thoroughly compacted and which 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
A	0.45	4,000	564	---	---
A-FA	0.45	4,000	480	110	125
X	---	2,000	376	---	---

- C. Except as otherwise indicated on the drawings or specified, all concrete shall be Class A or Class A-FA concrete.
- 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 at patches. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between four to seven percent by volume.
- H. CONTRACTOR shall submit to ENGINEER compressive strength of concrete cylinder test results for the same concrete mixes proposed on a previous 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 which can be adjusted to deliver the desired amount of water. All measuring, mixing, and proportioning equipment is subject to the approval of ENGINEER.

2.07 WATERSTOPS

- A. Hydrophilic waterstop shall be a flexible hydrophilic natural rubber strip composed of non-vulcanized rubber and urethane polymer hydrophilic agent creating a moisture-activated, selfhealing waterproofing compound.
- B. The hydrophilic waterstop shall be NSF Certified for potable water use (Adeka MC-2010MN).

- C. Hydrophilic waterstop shall be Adeka Ultraseal, or equal, products as follows:
1. Construction Joints:
    - a. 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%.
    - b. 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. Pipe Penetrations:
    - a. Wall/slab thickness between 4 inches and 9 inches and pipe diameter greater than 4 inches and less than or equal to 24 inches: KBA-1510FP (9/16 inch by 3/8 inch).
    - b. Wall/slab thickness greater than 9" and pipe diameter greater than 4" and less than or equal to 24 inches: MC-2005T (3/4 inch by 3/16 inch).
    - c. Wall/slab thickness greater than 9 inches and pipe diameter greater than 24 inches: MC-2010MN (3/4 inch by 3/8 inch) with embedded stainless steel wire mesh for expansion control.

## 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 Thorobond by BASF, Emaco P24 by BASF, or equal.

## 2.10 PATCHING ADDITIVE

- A. Acceptable manufacturers include ACRYL 60 by Harris Specialty Chemicals, Inc., Sonocrete by Sonneborn Contech Co., or equal.

## 2.11 NONSHRINK GROUT

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

## PART 3–EXECUTION

### 3.01 MIXING

- A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304 from an approved batching plant. 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 authorized by ENGINEER; the amount of water, if added, shall be recorded on all copies of the delivery tickets.
- D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the job site.
- 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 added at job, if any.
  - 7. Truck number and time dispatched.
  - 8. 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 which 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 30 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. Unless noted otherwise, hydrophilic waterstop shall be provided at all construction joints in liquid holding tanks and channels which are not adjacent to areas occupied by personnel and at joints between new and existing concrete. Waterstop shall be placed as shown on drawing details, if any, 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.
- B. 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 to 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.

### 3.05 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.

### 3.06 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 which will prevent the segregation or loss of materials. Chuting concrete directly into the form will not be allowed. Chuting for conveying purposes will be allowed only upon approval by ENGINEER and 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 and beam 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 due to rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. When concreting is once 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 assure adequate vibration in case of breakdown of those in use.
- J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.
- K. 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.
- L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

### 3.07 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 the forms are not going to be kept wet, 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 which are to be painted, receive ceramic tile or resilient flooring, or be waterproofed unless approved by ENGINEER. 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.

### 3.08 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 job site.
- 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.

### 3.09 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 three 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, Standard Specification

for Cold Weather Concreting, published by the American Concrete Institute, Detroit, Michigan, except as modified by the requirements of these specifications.

- B. Detailed procedures for the production, transportation, 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 accepted.
- 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-78 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 weather-tight 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 two 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 insure 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.

### 3.10 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 two 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 which appear shall be repaired to the satisfaction of ENGINEER. 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 as to insure complete filling of 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 and uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all painted 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 approved method to achieve a texture similar to 40-60 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 which has surface imperfections less than 3/8-inch in any dimension. Surface imperfections greater than 3/8-inch 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 which 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.

### 3.11 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 to insure that construction loads do not exceed design loading of the structure.

### 3.12 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.

### 3.13 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, 4 test cylinders shall be made for each pour between 25 and 100 cubic yards, and 8 test cylinders made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least 4 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 job site.
    - 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 result 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.

### 3.14 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.

### 3.15 SIDEWALKS AND EXTERIOR SLABS

- A. Sidewalks shall be constructed where shown on the drawings. They shall be a minimum of 5 inches thick and shall slope away from buildings or structures at a rate of 1/4-inch per foot. Concrete shall be as previously specified. Sidewalks shall be constructed on 3 inches

of compacted granular fill. They shall have tooled joints of 1-inch minimum depth at approximately 5-foot centers with 1/2-inch preformed expansion joint filler at approximately 25-foot centers with one at all corners and located anywhere sidewalks abut structures and buildings.

### 3.16 CONCRETE REMOVAL AND PATCHING

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

### 3.17 RESERVOIR TESTING AND DISINFECTION

- A. Water for testing and disinfection of the existing reservoir may be obtained from OWNER. Testing shall be done before placing reservoir back in service after all work is completed. Prior to both testing and chlorination, the reservoir shall be thoroughly cleaned and washed down.
- B. Reservoir testing shall be conducted prior to chlorination. If water from chlorination is of acceptable quality as defined below for chlorination, it may be discharged into the distribution system. If the water is found to be unacceptable, it shall be disposed of through the drain and waste equipment. To test the reservoir, it shall be filled to overflowing and be examined for running leaks. All running leaks shall be repaired by draining reservoir and repairing from the inside as above. Testing shall continue until all leaks are repaired.
- C. CONTRACTOR may disinfect the reservoir using one of the AWWA C652-02 methods which include the following methods:
  - 1. AWWA Method 2:
    - a. A solution of 200 mg/L available chlorine shall be applied directly to the surfaces of all parts of the reservoir which would be in contact with water when the reservoir is full to the overflow elevation.
    - b. The chlorine solution may be applied with suitable brushes or spray equipment. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water. The inside of the overflow piping need not be disinfected.
    - c. The surfaces disinfected shall remain in contact with the strong chlorine solution for at least 30 minutes, after which potable water shall be admitted, any drain piping shall be purged of the 10 mg/L chlorinated water, and the storage facility shall then be filled to its overflow level.
  - 2. AWWA Method 3:
    - a. Water and chlorine shall be added to the storage facility in amounts such that initially the solution will contain 50 mg/L available chlorine and will fill approximately 5% of the total storage volume. Chlorine shall be added to the storage facility by hand pouring chlorine granules onto the floor of the reservoir and allowing the incoming water to provide mixing. This solution shall be held in storage facility for a period of not less than six hours. The actual volume of the 50 mg/L chlorine solution shall be such that after the solution is mixed with filling water and the storage facility is held full for 24 hours there will be free chlorine residual of not less than 2 mg/L. The storage facility shall then be filled to the overflow level by flowing potable water into the highly chlorinated water and shall be held full for a period of not less than 24 hours. All highly chlorinated water shall then be purged from any drain piping.
    - b. Then, subject to satisfactory bacteriological testing by OWNER, leakage test, and acceptable aesthetic quality, including a 2 mg/L or less chlorine residual, such water may be served to the distribution system.

- c. If satisfactory chlorination is not achieved, CONTRACTOR shall repeat procedures or prepare other methods satisfactory to ENGINEER. Care should be taken in handling chlorine. Chlorine granules should be poured on dry surfaces, unless adequate precautions are taken to provide ventilation or protective breathing equipment. The same protective procedures shall apply to the application of liquid chlorine solutions. Should the chlorinated reservoir water be acceptable in all aspects except chlorine residual, water shall not be pumped to the distribution system. Highly chlorinated water shall be disposed of using a chlorine-reducing agent as provided for in AWWA C652-02 Appendix B. Additional water may be applied to reduce by dilution the chlorine residual to acceptable levels as determined by OWNER.

END OF SECTION

## SECTION 03415

### PRECAST CONCRETE HOLLOW CORE PLANKS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Precast concrete hollow core planks.
  - 2. Connection plates and hangers.
  - 3. Grouting plank joint keys.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ACI 318-Building Code Requirements for Reinforced Concrete.
- B. ASTM C150-Portland Cement.
- C. AWS D1.1-Structural Welding Code.
- D. AWS D1.4-Structural Welding Code-Reinforcing Steel.
- E. PCI-Manual For The Design of Hollow Core Slabs.
- F. PCI MNL-116—Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- G. PCI MNL-120—Design Handbook—Precast and Prestressed Concrete.
- H. PCI MNL-123—Manual on Design of Connections for Precast Prestressed Concrete.
- I. PCI-Design Handbook-Precast and Prestressed Concrete.
- J. PCI-Tolerances for Precast and Prestressed Concrete.

##### 1.03 DESIGN REQUIREMENTS

- A. Size components to withstand design loads in an unrestrained condition for roof assembly: All dead loads plus live loads plus concentrated loads shown on the drawings.
- B. Plank shall be capable of resisting shear forces as a diaphragm. Diaphragm chords will be the masonry bond beams.

#### 1.04 SUBMITTALS

- A. Shop Drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.
- B. Product Data: Indicate standard component configuration, design loads, deflections, and cambers.

#### 1.05 QUALIFICATIONS

- A. Fabricator: Company specializing in manufacturing the work of this section with three years experience. Maintain plant records and quality control program during production of precast planks. Make records available upon request.
- B. Erector: Company specializing in erecting the work of this Section approved by fabricator.
- C. Design precast concrete members in accordance with PCI Manual For The Design of Hollow Core Slabs under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Wisconsin.
- D. Welder: Qualified within previous 12 months in accordance with AWS D1.1.

#### 1.06 REGULATORY REQUIREMENTS

- A. Conform to ACI 318 and the Wisconsin Commercial Building Code for design load and on-site construction requirements.
- B. CONTRACTOR shall submit additional copies of shop drawings for submittal to the Department of Commerce by ENGINEER.

#### 1.07 PRE-INSTALLATION CONFERENCE

- A. Convene minimum one week prior to commencing work of this section under provisions of Section 01039—Coordination, Field Engineering and Meetings.
- B. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Lifting or handling devices shall be capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
- B. Mark each member with date of production and final position in structure.

#### 1.09 COORDINATION

- A. Coordinate the work of framing components not post tensioned but directly associated with the work of this section.
- B. Coordinate field cut openings with affected section.

- C. Coordinate location of hanger tabs and devices for mechanical and electrical work.
- D. Coordinate location of anchors to be placed in masonry walls.

## PART 2–PRODUCTS

### 2.01 FABRICATORS

- A. The plank shall be prestressed hollow-core precast concrete plank as fabricated by the Spancrete Company, Flexicore Company, or equal.

### 2.02 MATERIALS

- A. Materials shall comply with provisions of ACI 318.
- B. Cement grout for grouting joints shall be one part Portland Cement per ASTM C150, three parts sand and water.

### 2.03 ACCESSORIES

- A. Connecting and supporting devices shall be painted A36 steel unless noted otherwise.
- B. Bearing pads shall be high-density plastic, 1/8-inch-thick.
- C. Caulk as approved by plank manufacturer.

### 2.04 FABRICATION

- A. Conform to AWS D1.4., PCI MNL-116, and PCI MNL-120, and PCI MNL-123.
- B. Embed anchors, inserts, plates, angles, and other items at locations indicated.
- C. Cut exposed ends flush.

### 2.05 FINISHES

- A. Plank to be painted shall be field abrasive blasted and painted as specified in Section 09900–Painting.
- B. Connecting and supporting steel devices shall be prime painted per Section 09900–Painting. Do not paint surfaces in contact with concrete or surfaces requiring field welding.

### 2.06 FABRICATION TOLERANCES

- A. Conform to PCI-Tolerances for Precast and Prestressed Concrete.

## PART 3–EXECUTION

### 3.01 EXAMINATION

- A. Verify that site conditions and supporting structure are ready to receive work and field measurements are as indicated on shop drawings.

### 3.02 PREPARATION

- A. Prepare support devices for the erection procedure and temporary bracing.

### 3.03 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Align and maintain uniform horizontal and end joints as erection progresses.
- C. Maintain temporary bracing in place until final connection is made. Protect members from staining.
- D. Install bearing pads at bearing ends of planks as indicated.
- E. Adjust differential camber between precast members to tolerance before final attachment and grouting.
- F. Adjust differential elevation between precast members to tolerance before final attachment.
- G. Grout plank joints, trowel smooth. Any grout that may have seeped through to the ceiling below shall be removed before it hardens. Grout shall also be placed between masonry and underside of roof plank in spaces created by roof plank camber over all exterior walls and bearing walls. On nonbearing interior walls, a void over 1/2-inch shall be filled with 1/2-inch expansion material and grout the remainder. This grout shall be applied following roofing. It is the intent that a space of 1/4-inch to 1/2-inch be left for caulking as required in Section 07900–Caulking and Sealants.
- H. Underside of joints between planks that remain exposed shall be caulked with the plank manufacturer's material.
- I. Where open cores at end of planks are to remain exposed to view. The cores shall be grouted full for a minimum 6-inch depth to provide finished end of plank.
- J. Secure units in place. Perform welding, where shown, in accordance with AWS D1.1.

### 3.04 ERECTION TOLERANCES

- A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-116.

### 3.05 CUTTING OPENINGS

- A. Cooperation shall be extended all trades in permitting the insertion of anchors, hangers, vents, electrical outlets, etc. Holes needed for such devices shall be cut in the field by the

various trades. Cuts shall be made with a masonry saw or core drill. The various trades shall be present during installation of the roof deck. All openings not dimensioned or shown on the drawings shall be located by the trades requiring the openings. All openings larger than 8 inches in any dimension shall be made by the roof slab supplier, and where necessary, hangers shall be furnished by the supplier. All spalling shall be repaired by the roof plank supplier prior to caulking. It is essential that plank which will remain exposed from below have a neat finished surface. Particular care shall be given to appearance of holes and openings.

END OF SECTION

## SECTION 04100

### MORTAR AND MASONRY GROUT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. The work includes mortar and grout for masonry.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. Wisconsin Commercial Building Code.
- B. ASTM C144–Aggregate for Masonry Mortar.
- C. ASTM C150–Portland Cement.
- D. ASTM C207–Hydrated Lime for Masonry Purposes.
- E. ASTM C404–Aggregates for Masonry Grout.
- F. ASTM C476–Grout for Masonry
- G. ASTM C979–Pigments for Integrally Colored Mortar/Concrete.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.
- B. Submit information on Portland cement, integral waterproofing compound, and hydrated lime for mortar. Include design mix with proportions of materials being used. Submit gradation on aggregates.
- C. Submit design mix for grout including gradation of aggregates.
- D. Manufacturer's certificate: Certify that products meet or exceed specified requirements.

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

- A. All cement shall be stored in a dry, weatherproof, properly ventilated structure which will protect it from dampness and freezing.

##### 1.05 ENVIRONMENTAL REQUIREMENTS

- A. See Section 04300–Unit Masonry System, for cold weather requirements.

PART 2-PRODUCTS

2.01 MORTAR

- A. Mortar shall be Type S Portland cement-lime mortar with proportion restrictions as stated in the Wisconsin Commercial Building Code. Mortar and masonry cements will not be permitted. Provide integral waterproofing compound in mortar for all exterior masonry mortar.
- B. Portland cement shall conform to ASTM C150, Type I or III.
- C. Hydrated lime shall conform to ASTM C207, Type S.
- D. Integral waterproofing compound shall be Dry-Block by W.R. Grace Company, or equal.
- E. Mortar aggregate for ordinary tile, brick, stone, and block shall consist of clean, sharp sand, conforming to ASTM C144. The sand shall be graded within the following limits:

Sieve Number	Percent by Weight Passing
4	100
8	95 to 100
16	70 to 100
30	40 to 75
50	10 to 35
100	2 to 15
200	---

- F. Sand from any one source shall not vary over the extreme limits shown above. For unusually thin joints, such as occur with a unit having cut or ground edges, the aggregate used shall conform to these specifications except that 95% shall pass a No. 16 sieve.
- G. Water used in mixing water shall be clean and free of injurious materials.
- H. Mortar shall be thoroughly mixed until of uniform color and consistency. Only sufficient mortar to meet the immediate requirements of the work shall be mixed at one time. No mortar shall be retempered after it has begun to set, and no partially set mortar shall be used. No antifreeze material shall be used in the mortar to lower the freezing point.
- I. Colored mortar shall be provided for brick mortar. Colored mortar shall be Western Colored Masons Blend, premixed and colored as manufactured by Western Lime and Cement Company or equal. Color shall be selected by OWNER. White cement and sand will also be required for brick mortar.

2.02 GROUT

- A. Grout shall conform to ASTM C476-Mortar and Grout for Reinforced Masonry.
- B. Aggregates shall conform to ASTM C404-Aggregates for Masonry Grout.

- C. Grout shall have a minimum 28-day compressive strength of 2,500 psi with the following proportions:
  - 1. Fine Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate.
  - 2. Coarse Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate: 1 to 2 coarse aggregate.
  
- D. Fine grout shall be used in spaces with least horizontal dimension greater than 3/4 inches and less than 2 1/2 inches. Coarse grout shall be used in all spaces with least dimensions 2 1/2 inches or greater.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Brace masonry for wet grout pressure.
- B. Work grout into masonry cores and cavities.
- C. Where joints occur in grout, they shall be made 2 inches below the block joint so that a key is provided.
- D. Grout full masonry walls from top of floor to underside of all lintels at openings for a distance of 16 inches adjacent to each side of opening, unless shown otherwise on the drawings.

END OF SECTION

## SECTION 04300

### UNIT MASONRY SYSTEM

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Concrete block.
  - 2. Glazed concrete masonry units.
  - 3. Brick.
  - 4. Glass block.
  - 5. Reinforcement, anchorage, control joints, and accessories.
  - 6. Cold weather requirements.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. Wisconsin Commercial Building Code.
- B. ASTM C67—Sampling and Testing Brick and Structural Clay Tile.
- C. ASTM C90—Load Bearing Concrete Masonry Units.
- D. ASTM C216—Facing Brick.
- E. ASTM C744—Pre-Faced Concrete and Calcium Silicate Masonry Units.
- F. UL—Fire Resistance Directory.

##### 1.03 QUALITY ASSURANCE

- A. Variation from the plumb in the lines and surfaces of columns and walls shall not exceed 1/4-inch in 10 feet, 3/8-inch in a story height or 20 feet maximum, nor 1/2-inch in 40 feet or more. Variation from plumb for external corners, expansion joints, and other conspicuous lines shall not exceed 1/4-inch in any story or 20 feet maximum nor 1/2-inch in 40 feet or more.
- B. Variation from the level of the grades indicated on the drawing for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines shall not exceed 1/4-inch in any bay or 20 feet nor 1/2-inch in 40 feet or more.
- C. Variation of the linear building line from an established position in plan and related portion of columns, walls, and partitions shall not exceed 1/2-inch in any bay or 20 feet maximum nor 3/4-inch in 40 feet or more.
- D. Variation in cross-sectional dimensions of columns and thickness of walls shall not exceed minus 1/4-inch nor plus 1/2-inch from the dimensions indicated on the drawings.

#### 1.04 MOCK-UP

- A. Provide a 4-foot by 4-foot mock-up panel of masonry, including anchor accessories and flashings, before any masonry work begins. Location will be indicated by OWNER. Mock-up panel shall be approved by OWNER and used as a sample of the quality of work to be expected on the job. Mock-up may not remain as part of the work.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Masonry units, when delivered to the site, shall be thoroughly cured and shall be dry. When stored on the site, they shall not be in contact with the ground, shall be kept clean, and shall be covered with waterproof cover.

#### 1.06 COLD WEATHER REQUIREMENTS

- A. All masonry units delivered to use in freezing weather shall be fully protected by a weather-tight covering to prevent accumulation of ice on the units. Loose board covering will not be permitted.
- B. Cold Weather Protection:
  - 1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
  - 2. Remove all masonry determined to be frozen or damaged by freezing conditions.
  - 3. Perform the following construction procedure while the work is progressing. When air temperature is from 40°F (4°C) to 32°F (0°C), heat sand or mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C):
    - a. When air temperature is from 32°F (0°C) to 25°F (-4°C) heat sand or water to produce mortar temperature between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
    - b. When air temperature is from 25°F (-4°C) to 20°F (-7°C) heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.
    - c. When air temperature is from 20°F (-7°C) and below, heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); provide enclosures and auxiliary heat to maintain air temperature above 32°F (0°C); do not lay units which have a surface temperature of 20°F (-7°C).
  - 4. Perform the following protections for completed masonry and masonry not being worked on:
    - a. When the mean daily air temperature is from 40°F (4°C) to 32°F (0°C), protect masonry from rain or snow for at least 24 hours by covering with weather-restrictive membrane.
    - b. When the mean daily air temperature is from 32°F (0°C) to 25°F (-4°C), completely cover masonry with weather-restrictive membrane for at least 24 hours.
    - c. When the mean daily air temperature is from 25°F (-4°C) to 20°F (-7°C), completely cover masonry with insulating blankets or similar protection for at least 24 hours.

- d. When mean daily temperature is 20°F (-7°C) and below, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures, blankets, and supplementary heat.

## PART 2—PRODUCTS

### 2.01 CONCRETE BLOCK

- A. Concrete block shall be load bearing and shall conform to the requirements of ASTM Designation C90 and the Wisconsin Commercial Building Code. Bond shall be running bond. Concrete block shall be the two-cell-type and shall be made with normal weight aggregate.
- B. Unless otherwise indicated, interior concrete block at window sills and lintels, pilasters, and the top course of walls at roof lines shall be constructed of solid concrete block, lintel block filled with grout, or the cores of the block filled with grout. Interior block at window sills shall be solid concrete block unless otherwise noted. Bullnose block shall be used at all door, window, and wall corners that remain exposed.
- C. All interior concrete block walls shall extend to the underside of roof deck or floor above unless noted otherwise.

### 2.02 BRICK

- A. Face brick shall be ASTM C-216, latest edition, Grade SW, Type FBS, made from clay, shale, fine clay, or mixture thereof. All brick shall be free from cracks, laminations, and other defects which may interfere with proper laying of brick or impair the strength or permanence of the structure.
- B. A certificate of conformance as to grade and type shall be supplied by the manufacturer.
- C. Brick shall be by ACME Brick Company, color shall be Amaretto, and finish shall be Velour. CONTRACTOR shall submit brick samples to ENGINEER for approval. The bricks to be used shall be of Modular Size (7-5/8 by 2-1/4 by 3-5/8) and stack bond.
- D. Provide all brick masonry to complete work.

### 2.03 DECORATIVE CONCRETE BLOCK

- A. Glazed Concrete Masonry Units:
  - 1. Glazed concrete masonry units shall be used where indicated on the Finish Schedule bound at the back of these specifications.
  - 2. All glazed concrete masonry units shall be made with lightweight aggregate and shall be autoclaved units conforming to ASTM C90 as applicable. The glazed surface shall have a smooth satin-gloss finish and externally heat-polymerized cast-on facing conforming to ASTM C744, Federal Specification SS-C-621b, and ASTM C67, paragraph 8 (50 cycles of Freezing and Thawing).
  - 3. Glazed masonry units shall be used with colors selected by OWNER from manufacturer's standard colors.
  - 4. The glazed facing shall be free from chips, cracks, crazes, or any other imperfections that would detract from the overall appearance of the wall when viewed from a

distance of 5 feet at right angles to the wall. Only quality units shall be installed; all defective units shall be rejected.

5. Glazed units shall be ASTRA-GLAZE-SW as manufactured by Trenwyth Industries, Inc. or equal. All units shall include W.R. Grace DRY-Block water repellent block admixture or equal. Provide bullnose edge units at all door and window openings. Provide 2-inch-wide units at existing wall for veneer.

#### 2.04 GLASS BLOCK

- A. Glass block shall be 7 5/8-inch by 7 5/8-inch by 3 5/8-inch Vue brand by Pittsburgh Corning or equal.
- B. Panel Reinforcing: Two parallel 9 gauge wires either 1 5/8 inch or 2 inch on center with electrically butt-welded crosswires spaced at regular intervals, hot dipped galvanized after welding or Type 304 stainless steel, by Pittsburgh Corning Corporation.
- C. Panel Anchors: 20 gauge perforated steel strips 24 inches long by 1 3/4 inches wide, hot dipped galvanized after perforation or 22 gauge by 16 inches long by 1 3/4 inches wide of Type 304 stainless steel, by Pittsburgh Corning Corporation.
- D. Expansion Strips: Made of polyethylene foam with a thickness of 3/8 inch, by Pittsburgh Corning Corporation.
- E. Asphalt Emulsion: A water-based asphalt emulsion, by Karnak Chemical Corp. (Karnak 100, 1-800-526-4236), or equal.
- F. Channels (Aluminum): Available from Julius Blum & Company, Inc., 1-800-526-6293 in Carlstadt, NJ. Premiere Series (4-inch Glass Block) Use: 4 1/2-inch by 2-inch by 1/8-inch size.
- G. All mortar and bearing surfaces of the block shall be precoated or prepared to ensure adhesion between mortar and glass.

#### 2.05 REINFORCEMENT AND ANCHORAGE

- A. For concrete block walls, masonry wall reinforcement shall be Dur-O-Wal Truss Design manufactured by Dur-O-Wal Products, Blok-Trus manufactured by AA Wire Products Co., or equal.
- B. For cavity walls, masonry wall reinforcement shall be Dur-O-Wal Truss/Dur-O-Eye Design, or Econo-Cavity Blok-Trus AA 680, or equal.
- C. Wall reinforcement and ties shall be hot-dipped galvanized having a minimum 1.50 ounce/square foot zinc coating in accordance with ASTM A153 Class B2.
- D. Side rods shall be 9 gauge wire, and cross rods and tabs shall be 9 gauge wire. Maximum spacing of tabs shall be 24 inches.
- E. Prefabricated corner and tee sections shall be used to form continuous reinforcement around corners and for anchoring abutting walls and partitions.

- F. Reinforcing Bar Positioners: Where vertical reinforcing bars are required, provide bar positioners D/A 815 or D/A 816 by Durowall, or equal.

## 2.06 ACCESSORIES

- A. Cellular or honeycomb cell vents, 2 1/2 inches high, shall be provided at weep holes. Cell vents shall be U.V.-resistant polypropylene, Durowall D/A 1006, or equal.
- B. Vertical expansion control joints shall be located as shown on the drawings. Control joints shall be constructed with a factory extruded section of rubber equal to Dur-O-Wal Rapid Control Joint, AA Wire Products Co. Titewall, or equal and shall extend for the entire height of the wall. Care shall be taken to insure that the gap is free of mortar or debris. Control joint shall be caulked on exposed faces with caulk of a color to match mortar.
- C. See Section 07620–Flashing and Sheet Metal for masonry flashing specifications.

## 2.07 ANTIGRAFFITI COATING

- A. Antigrffiti coating shall be a clear, two-component, acrylic polyurethane that contains UV block and is a transparent graffiti-resistant barrier on concrete and masonry surfaces. Product shall be SWD Invisi-Shield Anti-Graffiti Clear by Sherwin Williams Company, or equal.
- B. Antigrffiti coating shall be applied to all existing and new exterior masonry (brick, stone, cast stone) wall surfaces.
- C. All surfaces to be coated shall be power washed to remove all contaminants and foreign debris. Apply one coat of HB150 15% silaxone solution by Sherwin Williams to weatherproof surfaces with coverage per manufacturer's recommendations. Then apply two sprayed coats of antigrffiti coating in coverages and methods recommended by manufacturer.

## PART 3–EXECUTION

### 3.01 MASONRY WORKMANSHIP

- A. All masonry shall be laid plumb and true to lines. Brick shall be laid with complete full mortar joints. Mortar beds shall be spread smooth or only slightly furrowed. The ends of brick shall be buttered with sufficient mortar to fill the end joint. The vertical longitudinal joint in solid brick walls shall be completely filled by parting, by pouring the vertical joint full of grout, or by shoving. Closures shall be rocked into place with the head joints thrown against the two adjacent brick in place.
- B. Block and brick shall be laid in stack bond, unless specified or shown otherwise.
- C. In laying brick and block masonry, the mason shall avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after being set in position. Where an adjustment must be made after the mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.

- D. In building cavity walls, the cavity shall be kept clean by slightly beveling the mortar bed to incline toward the cavity or by placing wood strips with attached wire pulls on the metal ties. The strips shall be withdrawn and cleaned before placing the next row of metal ties. Any mortar fins which protrude into the cavity space as the wall is built shall be troweled flat onto the inner face of the wythe.
- E. Where cutting of exposed masonry is necessary, the cuts shall be made with a motor-driven masonry saw or by other methods which provide cuts that are straight and true.
- F. Glazed concrete masonry units shall be cut using either an abrasive or diamond blade and cut units shall be cut neatly and located for best appearance.
- G. Where flashing is to be laid on or against masonry, the surface of the masonry shall be smooth and free from projections which might puncture the flashing material. Through-wall flashing shall be placed on a bed of mortar, and mortar shall be placed above the flashing.
- H. Weep holes spaced 32-inch on center 2 1/2 inches high shall be provided in the first course immediately above all flashing. Weep holes shall be kept free of mortar droppings.
- I. Outside joints around the perimeter of exterior door and window frames or other wall openings shall be not less than 1/4-inch nor more than 3/8-inch-wide and shall be cleaned out to a uniform depth of at least 3/4-inch ready for placement of caulk.
- J. All walls shall be adequately braced until they are completed and anchored to the roof construction.
- K. Construction designated as requiring "special observation" shall be constructed only in the presence of ENGINEER.
- L. All brick having initial rates of absorption in excess of 0.25 ounce per square inch per minute shall be wetted sufficiently so that the rate of absorption when laid does not exceed this amount. Wetting of units shall be such as to insure that each unit is nearly saturated, surface dry when laid. During freezing weather, units that require wetting shall be sprinkled with warm water just before laying.

### 3.02 MORTAR JOINTS

- A. All joints shall be laid plumb to lines. Unless specified otherwise, mortar beds shall be full 3/8-inch-thick and shall be spread smooth or only slightly furrowed. Vertical joints shall be shoved not over 3/8-inch-thick, unless otherwise shown. All joints shall be completely filled.
- B. Interior and exterior joints shall be tooled concave. All joints shall be tooled to uniform depth and shall be straight and true. Mortar joints shall be cut flush with masonry where rigid thermal insulation will be applied to interior masonry surfaces.
- C. Joints at glazed facing tile shall be 1/4-inch, tooled with a jointer of at least 1-inch-diameter, and with maximum deviation along joints of 1/16-inch in 2 feet. The laying of glazed concrete masonry units shall be consistent with the best concrete masonry practices. Units shall be aligned level, plumb, and true with uniform carefully tooled 1/4-inch-wide joints on the glazed face side of the wall.

### 3.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcement shall be installed in the first and second bed joint 8 inches apart immediately above lintels and below sills at openings. Elsewhere, spacing shall be at 16-inch vertical intervals or as shown on the drawings. Reinforcement in the second joint above and below openings shall extend 2 feet beyond the jambs. All other reinforcing shall be continuous.
- B. Side rods shall be lapped 6 inches minimum at splices. Reinforcement units shall be of widths required for wall thicknesses as shown. Reinforcement shall be placed to assure a 5/8-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces.
- C. Vertical reinforcing bars shall be installed using prefabricated bar positioners. Provide one positioner at the top of the first course of block and one additional positioner at a maximum spacing of 200 bar diameters.

### 3.04 BUILT-IN WORK

- A. As work progresses, install all built-in work (such as: window and door frames, anchor bolts, plates, lintels, etc.) to be provided by other sections.
- B. Install built-in items plumb and level.
- C. Bed anchors of metal door frames in adjacent mortar joints. Grout all steel door frames full with mortar except those called for to be "removable."
- D. Do not build-in organic materials subject to deterioration.
- E. Steel members embedded in exterior masonry shall be "battered" with not less than 1/2-inch of setting mortar on all surfaces.

### 3.05 JOINING OF WORK

- A. Where fresh masonry joins masonry that is partially set or totally set, the exposed surface of the set masonry shall be cleaned and lightly wetted so as to obtain the best possible bond with the new work. All loose brick and mortar shall be removed. If it becomes necessary to "stop-off" a horizontal run of masonry, this shall be done only by racking back brick in each course, and if grout is used, stopping grout four inches back of the rack. Tothing will not be permitted.

### 3.06 PROTECTION OF WORK

- A. During erection, all walls shall be kept dry by covering at the end of each day or shutdown period with a canvas or waterproof covering. Partially completed walls not being worked on shall be similarly protected at all times. All covering shall overhang at least two feet on each side of the wall and shall be securely anchored.

### 3.07 MASONRY CONTROL JOINTS

- A. Provide vertical masonry control joints in brick and block as detailed on the drawings.

- B. Where control joint locations are not shown on the drawings, they shall be provided as follows:

	Brick Veneer
Distance from wall corner (maximum)	15 feet
Spacing between joints (maximum)	30 feet

- C. Where possible, joints shall be located at edges of door, window, and louver openings, and at changes in wall height.

3.08 CLEANING NEW WORK

- A. Masonry faces to remain exposed shall be wiped with a damp cloth as the work progresses and thoroughly cleaned and pointed upon completion. If stiff brushes and water will not suffice, the surface shall be thoroughly wetted with plain water and then scrubbed with a 5 or 10% solution of hydrochloric acid. Alternatively, a commercial cleaner such as Sure Klean, or equal, may be used. Immediately after, the surface shall be washed to remove all traces of acid. All surfaces not being cleaned shall be protected from the acid. All mortar shall be removed from surfaces other than masonry.
- B. Glazed masonry walls shall be cleaned with a detergent masonry cleaner containing no muriatic acid strictly following the cleaner manufacturer's instructions, including thorough rinsing.

3.09 EXISTING MASONRY

- A. Openings in existing walls which are to be filled shall be filled with masonry units to match existing.
- B. Where possible, new openings in existing masonry shall be sawcut.
- C. Provide all necessary removals and repairs required for installation of new louvers, fans, openings, etc.
- D. At lintel bearings of all new openings, grout masonry full for 16 inches full height on both sides of opening.
- E. Repair all masonry damaged during construction.
- F. All existing masonry which will remain exposed shall be cleaned as specified for new masonry.
- G. New units shall be toothed into existing units.
- H. Masonry reinforcing shall be carried through new units.

END OF SECTION

## SECTION 05400

### COLD FORMED STEEL FRAMING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Exterior “C” shaped nonload-bearing steel framing including studs, tracks, and accessories for masonry veneer backup and support of fiber reinforced concrete panels and soffits.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. AISI–Specification for the Design of Cold Iron and Steel Structural Members.
- B. ASCE 7–Building Codes Requirements for Minimum Design Loads in Buildings and Other Structures.
- C. ASTM A90–Standard Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- D. ASTM A446/A–Standard Specification for Steel Sheet, Zinc-Coated (Galvanized by the Hot-Dip Process, Structural (Physical) Quality.
- E. ASTM A570/A–Standard Specifications for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
- F. ASTM A611–Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Structural Quality.
- G. ASTM C954–Standard Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inches (0.84 mm) to 0.112 inches (2.84 mm) in thickness.
- H. ASTM C1007–Standard Specification for Installation of Load-Bearing (Transverse and Axial) Steel Studs and Related Accessories.

##### 1.03 SUBMITTALS FOR REVIEW

- A. Submittals shall be in accordance with provisions of Section 01300–Submittals.
- B. Product Data: Submit copies of manufacturer’s product information and installation instructions for each item of cold-formed steel framing and accessories.
- C. Shop Drawings: Submit shop drawings for prefabricated panel assemblies, components, and installations to be on- or off-site fabricated. Include placing drawings for framing members showing size and gage designations, number, type, location, and spacing.

Indicate supplemental strapping, bracing, splices, accessories, type and location of welds, bolts and fastening devices, and details required for proper installation.

- D. Submit complete design calculations for all systems and design dead and live loads. Include design for all connections.
- E. Submit Welder and Welding Operation Qualification Test Record Certification for all welders and welding operators to be used.

#### 1.04 DESIGN REQUIREMENTS

- A. Calculations and erection plans shall be prepared by, or under direct supervision of, a Registered Professional Engineer in the State of Wisconsin, sealed, and signed.
- B. Follow the AISI Code for light gage materials.
- C. Design for positive and negative direct wind loads and uplift as calculated per ASCE-7 and noted on the drawings. Limit maximum lateral deflection to L/360 with the stud backup system alone taking the wind load.
- D. Do not consider composite action with sheathing or brick in preparing calculations. Limit spandrel panel deflections to 1/4-inch at window heads and sills regardless of span.
- E. Provide slip connections to allow deflection of roof structure without loading studs.
- F. Design and provide all necessary bridging.

#### 1.05 QUALITY ASSURANCE

- A. Composite Design: Compute structural properties of studs following referenced AISI standard.
- B. Qualifications for Welding Work:
  - 1. Qualify welding processes and welded operators following American Welding Society (AWS) D1.1 "Structural Welding Code-Steel."
  - 2. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
  - 3. If recertification of welders is required, retesting will be CONTRACTOR's responsibility.

#### 1.06 INSPECTION AND QUALITY CONTROL

- A. Provide effective, full-time quality control over all fabrication and erection activities.
- B. Steel framing manufacturer shall provide a qualified representative for on-site review of fabrication and installation following manufacturer's recommendations.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packaging and Delivery: Deliver to project site in manufacturer's original, unopened packaging or bundles, fully identified with name, type, and grade. Time delivery to minimize

on-site storage time. Inspect components upon arrival; reject and remove damaged, rusted, or deformed units.

- B. Storage: Store off the ground in a dry ventilated space; protect from rusting and damage.

## 1.08 SEQUENCING AND SCHEDULING

- A. General: Schedule installation only after structural steel system and metal decking have been erected, braced, and permanently secured and where applicable back-up masonry wall systems have been installed, cleaned, and approved.

## PART 2-PRODUCTS

### 2.01 MANUFACTURERS

- A. Contingent on meeting specified requirements, manufacturers offering "C"-shaped, load-bearing and nonloading-bearing steel studs (and joists) to be incorporated in the work include, but are not limited to the following:
  1. Clark Western.
  2. Dietrich Industries, Inc.
  3. UNIMAST Incorporated.
- B. Manufacturer shall be a member of the Steel Stud Manufacturer's Association (SSMA).

### 2.02 STEEL FRAMING

- A. System Components: For each type of steel framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories recommended by manufacturer for applications indicated as needed to provide a complete steel framing system.

### 2.03 MATERIALS

- A. Studs: Manufacturer's standard load-bearing steel studs in widths, shape, and gauge indicated on Drawings. For gauges noted on drawing, comply with the following requirements:
  1. 14 and 16 gauge punched "Cee" studs: Formed from 40,000 or 50,000 psi yield strength steel following ASTM A570 (painted members) or ASTM A446, Grade D (galvanized members).
  2. 18 and 20 gauge punched "Cee" studs: Formed from 33,000 psi yield strength steel following ASTM A611, Grade C (painted members) or ASTM A446, Grade A (galvanized members).
- B. Metal Track and Bridging: Provide regular leg, deep leg, and bent plate track as applicable for condition and as indicated on the drawings. Bridging may be "Vee" or channel-shaped. Provide in same gauge and finish as component to which attached.
- C. Strapping, bridging, and related wall framing accessories: Formed/fabricated from 33,000 psi yield strength steel following ASTM A611, Grade C (painted members); ASTM A446, Grade A (galvanized members).

- D. Provide miscellaneous galvanized sheet steel shape indicated on Drawings.
- E. Provide galvanized finish to steel framing components and accessories in exterior walls complying with ASTM A525 for minimum G 60 coating.
- F. Provide prime coated finish to steel framing components and accessories in interior walls with one coat of shop-applied red oxide, zinc chromate, or other similar rust inhibitive primer.
- G. Fasteners: Corrosion-resistant cadmium-plated screws, nuts, bolts, washers, and other fasteners. Provide hot-dip galvanized expansion bolts if indicated on the drawings.
- H. Welding Electrodes: Shielded metal arc welding shall be made following the AWS "Specification for Welding Sheet Steel in Structures" and its commentary.
- I. Rolled Steel Plates, Shapes and Bars: Conform to ASTM A36.
- J. Stud Anchors: Headed studs for embedment in concrete. Manufactured from cold drawing bar stock, conforming to ASTM A108 as manufactured by TRW, Nelson Division.
- K. Zinc Rich Touch-up Paint: For damaged surfaces and weld touch-up, provide Lindsay Zinc Dust-Zinc Oxide 641 Primer, Tnemec 90-93 Tneme-Zinc, or Koppers Organic Zinc.

#### 2.04 FABRICATION

- A. General: Framing components may be prefabricated into panels on- or off-site prior to erection. Fabricate panels plumb, square, true to line, and braced against racking and joints welded and screwed as required. Perform lifting of prefabricated panels in a manner to prevent damage or distortion to members in the assembly.
- B. Fabricate panels in jig templates to hold in proper alignment and position and to assure consistent component placement.
- C. Cut all components squarely for attachment to perpendicular members or as required for an angular fit against abutting members.
- D. Fastening: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, manufacturer's standard. Wire tying of framing components is not permitted.
- E. Install axially loaded studs in a manner which will ensure that ends are positioned against the inside of runner web prior to fastening.
- F. Preinstall insulation equal to that specified elsewhere in all double jamb studs and doubled headers not accessible to insulation contractors.
- G. Fabrication Tolerances: Fabricate and install framed components to the following tolerances:
  - 1. Maximum Variations from True Position: 1/8-inch in 10 feet.
  - 2. Maximum Offset of any Member from Plane: 1/8-inch in 10 feet.
  - 3. Maximum Offset between Prefabricated Panels: 1/8-inch in 10 feet.

## 2.05 FINISHES

- A. Clean welds, removing spatter and slag. Apply one or more coats of touch-up paint.
- B. Spot prime painted members with primer compatible with component manufacturer's primer.
- C. Spot prime galvanized members with zinc-enriched primer formulated especially for painting of galvanized surfaces.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. General: Install steel framing systems following manufacturer's printed or written instructions and recommendations, unless otherwise indicated.
- B. Runner Tracks: Install continuous tracks sized to match studs. Provide sill sealer on top of exterior foundation walls to inhibit air infiltration. Align tracks accurately to the layout at base and tops of studs. Secure tracks as recommended by the stud manufacturer for the type of construction involved, except do not exceed 24-inch o.c. spacing for nail or power-driven fasteners, or 16-inch centers for other types of attachment. Provide fasteners at corners and ends of tracks.
- C. Installation of Wall Stud System:
  - 1. Secure studs to top and bottom runner tracks by welding and/or screw fastening at both inside and outside flanges.
  - 2. Set studs plumb except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
  - 3. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.
  - 4. Install supplementary framing, blocking, and bracing in the steel framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, follow the stud manufacturer's recommendations and industry standards in each case considering the weight or loading resulting from the item supported.
  - 5. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full height studs of the wall. Secure stud system wall opening in the manner indicated.
  - 6. Frame both sides of expansion and control joints, as shown on the wall system, with separate studs; do not bridge the joint with components of the stud system.
  - 7. Install horizontal stiffeners in stud system, spaced as recommended by the manufacturer and at locations required by load-bearing conditions. Weld at each intersection.
  - 8. Unless specifically noted otherwise, all studs shall extend full height from floor to roof deck. Drywall and sound batt insulation shall extend full height to roof structure around rooms as indicated on the drawings and shall extend 1 foot above ceiling elsewhere.

- D. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints. Maximum variations in plan and true positions between prefabricated assemblies should not exceed 1/16-inch.
- E. Field Touch-up Painting:
1. Field spot prime welded and screwed connections as erection proceeds with primer compatible with factory-applied coatings.
  2. Painted Members: Use primer compatible with shop-applied protective coatings to touch up areas damaged during handling and installation.
  3. Galvanized Members: Use compatible galvanizing zinc-rich primer for galvanized surfaces. Brush or spray onto a minimum 2 mil dry film thickness.

END OF SECTION

## SECTION 05500

### METAL FABRICATIONS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Shop-fabricated carbon steel, stainless steel, and aluminum items, including lintels.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A36–Structural Steel.
- B. ASTM A53–Pipe, Steel, Black, and Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
- C. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A143–Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- E. ASTM A153–Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A176–Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
- G. ASTM A307–Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- H. ASTM A384–Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- I. ASTM A385–Practice for Providing High Quality Zinc Coatings (Hot-Dipped).
- J. ASTM A570–Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.
- K. ASTM A611–Steel Sheet, Carbon, Cold-Rolled, Structural Quality.
- L. ASTM B209–Aluminum and Aluminum-Alloy Sheet and Plate.
- M. ASTM B211–Aluminum-Alloy Bar, Rod, and Wire.
- N. ASTM B221–Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.
- O. AWS A2.0–Standard Welding Symbols.
- P. AWS D1.1–Structural Welding Code.

### 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 01300–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. 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. Mill Test Reports: Submit indicating structural strength and composition.
- C. 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 insure 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–CARBON STEEL

- A. Steel Sections:
  - 1. ASTM A36 (channels, angles, plates).
  - 2. ASTM A992-50 (wide flange sections).

3. Pipe: ASTM A53, Grade B.
4. Tubes: ASTM 500, Grade B.

- B. Sheet Steel: ASTM A570 or A611.
- C. Plain Washers: Round carbon steel complying with FS FF-W-92.
- D. Bolts and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.
- E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.
- F. Welding Materials: AWS D1.1; E70XX electrodes.
- G. Select fasteners for the type, grade, and class required.

## 2.02 MATERIALS—STAINLESS STEEL

- A. Unless otherwise noted, all stainless steel shall meet the requirements of ASTM A240 and shall be Type 316L.
- B. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.

## 2.03 MATERIALS—ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.
- B. Sheet Aluminum: ASTM B209, Alloy 3005.
- C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.
- D. Bolts, Nuts, and Washers: Stainless steel.
- E. Welding Materials: AWS D1.1; type required for materials being welded.

## 2.04 ACCESSORIES

- A. Stair Treads: Stair treads for aluminum stairs shall be constructed of nonslip grating and shall have an integral nosing. Treads shall be IKG Industries, or equal, serrated, aluminum swage-locked treads with 1 1/4-inch abrasive nosing.

## 2.05 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.

## 2.06 MISCELLANEOUS METAL FABRICATION

- A. Stainless Steel Ladder: Provide fixed stainless steel ladder as shown on the drawings. Stainless steel ladder shall have serrated surface on rungs.

## 2.07 FINISHES

- A. Carbon steel surfaces shall be prepared by abrasive blasting to SSPC-SP10 as specified in Section 09900–Painting.
- B. Do not prime surfaces where galvanizing or field welding is required.
- C. Immediately after surface preparation, prime paint carbon steel items with one coat in accordance with manufacturer’s instructions and Section 09900–Painting.
- D. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.

- E. Surfaces which will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.
- F. Galvanizing:
  - 1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
  - 2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in "Recommended Details for Galvanized Structures" as published by the American Hot Dip Galvanizer's Association, Inc.
  - 3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
  - 4. Steel shall conform to ASTM A36 except that the silicone content shall be in the range of 0 to 0.04%.
  - 5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
  - 6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, "Welding Zinc Coated Steel." All uncoated weld areas shall be touched up.
- G. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

## 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. Setting Precast Anchorages:
  - 1. Clean bearing surfaces free from bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.

2. After the bearing members have been positioned and plumbed, tighten and anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
  3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- B. 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.
- C. 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 which are not to be left as exposed joints, grind joints smooth, and touch-up shop paint coat or galvanizing repair.
- D. Weirs and Baffles:
1. Provide watertight splice plates at joints between sections of weirs and baffles.
  2. Weirs and baffles shall be installed level with a tolerance of  $\pm 1/8$ -inch.

#### 3.04 FIELD WELDING

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

#### 3.05 TOUCH-UP PAINTING

- A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting in accordance with Section 09900–Painting.

#### 3.06 GALVANIZING REPAIR

- A. Areas damaged by welding, flame-cutting or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16-inch in width.
1. Cold Galvanizing Compound:
    - a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
    - b. Areas to be repaired shall be power disc-sanded to bright metal. To ensure that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
    - c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
    - d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
    - e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

2. Zinc-Based Solder:
  - a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
  - b. Areas to be repaired shall be wire brushed.
  - c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
  - d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

### 3.07 SCHEDULE

- A. The following schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Guard Posts: Steel pipe, concrete-filled, crowned cap, as detailed-galvanized and field finish paint per Division 9.
- C. Lintels: Shop prime paint finish for interior wall lintels; galvanized and field finish paint per Division 9 for exterior wall lintels. Lintels reviewed by ENGINEER shall be placed over all masonry openings, even though not shown on the drawings. See lintel schedule on the drawings.
- D. Stainless steel ladder, mill finish.
- E. Steel building framing, shop primed and held finished where exposed.
- F. Aluminum grating and stair supports, mill finish.

END OF SECTION

## SECTION 05531

### GRATINGS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes floor and stair tread grating.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 PERFORMANCE REQUIREMENTS

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

##### 1.03 FIELD MEASUREMENTS

- A. 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: IKG Industries, Type 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.
- 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.
- F. For aluminum grating stair treads, refer to Section 05500–Metal Fabrications.

##### 2.02 FINISHES

- A. Any aluminum in contact with concrete shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

## PART 3-EXECUTION

### 3.01 EXAMINATION

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Verify that supports are correctly positioned.

### 3.02 INSTALLATION

- A. Place frames and supports in correct position, plumb and level.
- B. All aluminum floor grating 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.

END OF SECTION

## SECTION 05560

### ANCHOR BOLTS, EXPANSION BOLTS, AND ADHESIVE ANCHORS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Anchor bolts, expansion bolts, and adhesive anchors.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A36/A36M–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.

#### 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 Power-Stud + SD2 by Powers Fastening Systems, Strong-Bolt, by Simpson Strong-Tie Anchor Systems, or equal.
- B. Unless waived by ENGINEER for certain applications, all expansion bolts shall comply with the Wisconsin Commercial Building Code and AC 193. 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 PE 1000+ by Powers Fastening Systems, Set-XP by Simpson Strong-Tie Anchor Systems, or equal.
- B. Unless waived by ENGINEER for certain applications, all adhesive anchors shall comply with the Wisconsin Commercial Building Code and ACI 318. 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 recommendations.
- B. Bolt embedment shall at least equal six bolt diameters.
- C. All procedures shall be in accordance with the manufacturer's recommendations.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and bolts and 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. All procedures shall be in accordance with the manufacturer's recommendations.

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

END OF SECTION

## SECTION 06112

### WOOD FRAMING AND SHEATHING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work included: Wall.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. APA–American Plywood Association.
- C. AWWA–American Wood Preservers Association.
- D. NFPA–National Forest Products Association.
- E. NLGA–National Lumber Grades Authority.
- F. SPIB–Southern Pine Inspection Bureau.
- G. WCLIB–West Coast Lumber Inspection Bureau.
- H. WWPA–Western Wood Products Association.

##### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber and other building materials and keep under cover both in transit and at the job site. Protect from dampness. Stack framing lumber and plywood to insure proper air circulation. Locate stacks on well-drained areas. Support 6 inches above grade and protect with waterproof cover.

#### PART 2–PRODUCTS

##### 2.01 MATERIALS

- A. Lumber shall be kiln-dried with moisture content not to exceed 19% at time of installation and grade marked according to the National Lumber Manufacturer's Association.
- B. Plywood wall sheathing shall be grade C-D Ext., or better, graded in accordance with the American Plywood Association.
- C. Wood sills, plates, blocking, etc., to be same grade as studs.

## PART 3-EXECUTION

### 3.01 PLYWOOD SHEATHING

- A. Plywood sheathing shall be nailed at 6 inches on center at edges and 12 inches on center at intermediate supports with 8d common nails.
- B. Secure wall sheathing with long dimension perpendicular to wall studs with ends over firm bearing and staggered.

### 3.02 CONNECTIONS

- A. All framing connections and nailing shall be in accordance with the details shown and/or the Wisconsin Commercial Building Code minimum requirements, whichever is more restrictive.
- B. Connectors shall be installed in accordance with manufacturer's requirements.

END OF SECTION

## SECTION 06114

### WOOD BLOCKING AND CURBING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Roof curbs and cants.
  - 2. Wood blocking.
  - 3. Wood furring and grounds.
  - 4. Preservative treatment of wood.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. AWWA–American Wood Preservers Association.
- C. NFPA–National Forest Products Association.
- D. NLGA–National Lumber Grades Authority.
- E. SPIB–Southern Pine Inspection Bureau.
- F. WCLIB–West Coast Lumber Inspection Bureau.
- G. WWPA–Western Wood Products Association.

##### 1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300–Submittals.
- B. Certification of type of wood and wood treatment to be used.

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

- A. All materials shall be thoroughly sealed and protected from weather during transport and at the job site. Protect from dampness.

#### PART 2–PRODUCTS

##### 2.01 MATERIALS

- A. Lumber for roof curbs, cants, blocking, furring, and grounds shall be “standard” grade Douglas Fir, No. 2 Southern Pine, or better, graded in accordance with the WWPA, WCLIB, NLGA, or SPIB grading rules as applicable. Lumber shall bear the grading agency’s stamp.

- B. Wood shall be kiln-dried with moisture content not to exceed 19% at time of installation.
- C. All lumber furnished under this section shall be pressure-treated with a chromated copper arsenite (CCA) waterborne preservative to a minimum retention of 0.40 pounds per cubic foot. Acceptable products include Hoover Treated Wood Products CCA, Wood Preserving Co. Osmose CCA, or equal. Cuts shall be treated in the field with a brush-on waterborne preservative compatible with the pressure treatment.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Provide and install wood curbs, cants, blocking, furring, and grounds of proper size and shape where shown on the drawings and where required to secure other work or equipment in place.
- B. Members shall be installed true to lines, level, plumb, and secure.
- C. Connections and nailing shall be in accordance with the details shown and/or the Wisconsin Commercial Building Code minimum requirements, whichever is more restrictive.
- D. Apply brush-on wood preservative treatment to cuts in accordance with manufacturer's recommendations.

END OF SECTION

## SECTION 07112

### RUBBERIZED ASPHALT MEMBRANE

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes self-adhesive rubberized asphalt sheet membrane waterproofing system for top of existing reservoir slab.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300–Submittals.
- B. Shop drawings shall include product data, layout plan, joint and termination details, details of interface with other materials, and copy of manufacturer's warranty.

##### 1.03 QUALITY ASSURANCE

- A. The manufacturer of the waterproofing membrane system shall have 10 years experience producing self-adhesive sheet membrane waterproofing.
- B. Waterproofing system shall be installed by an applicator who is thoroughly familiar with the system and has experience in performing the work of this section.
- C. Manufacturer's representative shall be on-site periodically during membrane waterproofing work to review installation procedures.

##### 1.04 WARRANTY

- A. Provide manufacturer's written 5-year material warranty to OWNER at successful completion of the project.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURER

- A. Acceptable manufacturers include the following, or equal: W.R. Grace & Co., Connecticut.

##### 2.02 MATERIALS

- A. Self-adhesive, cold-applied composite sheet membrane shall be 65 mils total thickness consisting of a high-strength, heat-resistant woven polypropylene mesh embedded in a layer of rubberized asphalt; Bituthene 5000, or equal. Rubberized asphalt membrane shall be covered with release paper which is removed during installation. No special adhesive or heat shall be required to form laps.

- B. Primer, mastic, liquid membrane, and accessories shall be provided by or acceptable to the membrane manufacturer.

### PART 3—EXECUTION

#### 3.01 EXAMINATION

- A. Examine surfaces to receive waterproofing membrane for conditions that may be detrimental to the proper completion of the work. Do not commence work until all defects are remedied.

#### 3.02 PREPARATION

- A. Substrates shall be prepared as recommended by manufacturer. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil, and wax from exposed surfaces. Remove dust, dirt, loose stone, and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.
- B. Treat joints and install flashings as recommended by waterproofing manufacturer.

#### 3.03 INSTALLATION

- A. Membrane shall be installed in accordance with manufacturer's recommendations, including but not limited to, the following:
  1. Apply primer at the rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of primer.
  2. Delay application of membrane until primer is completely dry. Dry time will vary with weather conditions.
  3. Seal daily terminations with troweled bread of mastic.

#### 3.04 CLEANING AND PROTECTION

- A. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.
- B. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION

## SECTION 07191

### VAPOR AND AIR BARRIER

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes:
  - 1. Vapor barrier under concrete floors on grade, in exterior construction, and on top of precast roof plank.
  - 2. Air barrier on exterior of block and wall sheathing wythe as shown on drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 MATERIALS

- A. Vapor barrier for below slabs: Vapor barrier shall consist of 10 mil ASTM E1745 Class B polyethylene sheeting with less than 0.3 perm water vapor permeance in accordance with ASTM E96.
- B. Air barrier for masonry cavity wall construction shall be fluid applied air and vapor barrier membrane, ExoAir 120 by Tremco, or equal. Apply to outside face of inner wythe of concrete block or wall sheathing prior to installation of rigid insulation. Apply in strict accordance with manufacturer's or wall sheathing instructions. Air barrier shall be in all new cavity wall and rain screen cladding construction on the project.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION–UNDER CONCRETE FLOORS ON GRADE

- A. Provide continuous vapor barrier under concrete floors on grade that are 8 inches or less in thickness, lap all joints a minimum of 12 inches.
- B. Place 6 inches of granular cushion under vapor barrier.

##### 3.02 INSTALLATION OF AIR BARRIER

- A. Install air barrier on exterior side of concrete block or exterior wall sheathing.
- B. Install air barrier per manufacturer's recommendations and approved details.

END OF SECTION

SECTION 07212  
BOARD INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes board insulation for cavity and rain-screen wall construction, for perimeter foundation walls, and under floor slabs-on-grade.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 CAVITY AND RAIN-SCREEN WALL INSULATION

- A. Cavity and rain-screen wall insulation shall be 1 1/2-inch-thick polyisocyanurate foam board with aluminum facing on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 10.0.
- B. Acceptable products include the following, or equal. Thermax White Finish Insulation by DOW Corporation.
- C. Adhesive for adhering insulation to backup wall shall be as recommended by the insulation manufacturer.
- D. Insulation joint and edge tape shall be Thermax white foil tape.

2.02 FOUNDATION AND UNDER-SLAB INSULATION

- A. Foundation and under-slab insulation shall be 2-inch-thick extruded polystyrene closed cell rigid foam board with continuous skins on both sides. Aged thermal resistance (R-value) at 75°F shall be a minimum of 10.0
- B. Acceptable products include the following, or equal:
  - 1. Styrofoam Square Edge by Dow Chemical Company.
  - 2. Foamular 250 by UC Industries, Inc.

PART 3–EXECUTION

3.01 INSTALLATION–CAVITY WALLS

- A. Insulation shall be installed horizontally within the cavity space between masonry wythes.
- B. Take care during installation to ensure all insulation boards are butted and installed between ties and fit flush against inner wythe or backup wall.

- C. Cut insulation neatly to fit around obstructions across the cavity such as vents, louvers, pipes, and conduits.
- D. Secure insulation in place against backup wall with mastic adhesive and observe label directions.
- E. All joints and edges of insulation shall be taped to limit air and water infiltration.

3.02 INSTALLATION—FOUNDATION WALLS AND UNDER FLOORS

- A. Rigid insulation shall be laid dry against the foundation walls as backfill is placed. Insulation shall be located at all perimeter frost walls and below-grade walls of buildings and structures containing areas that may be occupied by personnel.

END OF SECTION

SECTION 07213  
BATT INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes batt insulation.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C665–Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

PART 2–PRODUCTS

2.01 EXTERIOR WALL INSULATION

- A. All batt insulation in attic spaces shall be unfaced or foil-reinforced kraft faced meeting the Wisconsin Commercial Building Code or governing local building code requirements.
- B. Wall insulation in exterior walls shall be 6-inch-thick unfaced fiberglass batt conforming to ASTM-C665, Type 1, and providing a minimum R-value of 19. Thickness shall match wall framing, and widths of batts shall be compatible with wall framing spacing.
- C. Acceptable manufacturers include the following or equal:
  - 1. Owens Corning.
  - 2. Manville.
  - 3. Certainteed.

PART 3–EXECUTION

3.01 INSTALLATION–WALL INSULATION

- A. Install per manufacturer's recommendations.
- B. Carefully cut insulation around wall penetrations.
- C. Friction fit insulation between studs.

END OF SECTION

## SECTION 07270

### FIRESTOPPING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Silicone firestopping foam for sealing annular spaces around ductwork penetrations through fire-rated assemblies.
  - 2. Silicone firestopping sealant for sealing annular spaces around piping and conduit penetrations through fire-rated assemblies and to seal gaps at intersections of walls and floors/ceilings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. UL 1479–Fire Tests of Through-Penetration Firestops.
- B. UL–Fire Hazard Classifications.

##### 1.03 REGULATORY REQUIREMENTS

- A. Firestopping materials and installation shall conform to the Wisconsin Commercial Building Code requirements, including fire resistance ratings and surface burning characteristics.
- B. Provide certificate of compliance from local building inspector indicating approval of firestopping materials and installation.

##### 1.04 ENVIRONMENTAL REQUIREMENTS

- A. A small amount of hydrogen gas is released as the firestopping foam cures. Use forced air ventilation when installing if areas of installation have less than 2 cubic feet of free air for each pound of liquid mixture being formed.

#### PART 2–PRODUCTS

##### 2.01 FIRESTOPPING FOAM

- A. Firestopping foam for duct penetrations through fire-rated assemblies shall be a foamed-in-place silicone elastomer produced from two liquid components.
- B. Acceptable products include the following, or equal: Fire Barrier 2001 Silicone RTV Foam by 3 M Corporation.

## 2.02 FIRESTOPPING SEALANT

- A. Firestopping sealant for piping and conduit penetrations through fire-rated assemblies shall be a single-component silicone elastomer.
- B. Acceptable products include the following, or equal: Fire Barrier Silicone Sealant 2000 by 3 M Corporation.

## 2.03 DAMMING MATERIAL

- A. Damming material shall be fire-resistant mineral fiber (if left in place) or other combustible material (if removed) as directed by the appropriate fire-tested designs.

## 2.04 PRIMER AND WRAP STRIP

- A. Primer for firestopping sealant shall be 3M Corporation, or equal.
- B. Wrap strip for firestopping sealant shall be 3M Fire Barrier FS-195 Wrap/Strip, or equal.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Firestopping foam and sealant shall be applied according to manufacturer's written instructions and shall achieve a fire rating equal to rating of construction which is penetrated. Substrate shall be free of all combustible materials (except damming material for later removal), loose impediment, oil, and other free liquids.
- B. Install damming material to establish the thickness and hold the firestopping foam/sealant in place. Follow the manufacturer's installation instructions. All gaps or cracks left after damming materials are in place must be sealed.
- C. Firestopping Foam: Immediately after mixing, dispense liquid foam into the penetration opening in accordance with manufacturer's installation instructions. Do not overfill penetration openings with liquid foam. Foam expands approximately three times its original volume during cure. Follow manufacturer's guidelines. If the opening is not filled when the cured foam has completed its expansion, repeat the installation and cure procedure until the opening is filled to the desired level. Allow 15 minutes between application of each shot.
- D. Firestopping Sealant: Apply primer and wrap strip in accordance with manufacturer's instructions prior to installing sealant. Apply sealant to a minimum depth of 1 1/2 inches and with uniform density and texture.
- E. Remove combustible damming material after foam/sealant has cured. Noncombustible damming material may be left in place.

### 3.02 QUALITY CONTROL

#### A. Firestopping Foam:

1. Perform manufacturer's four-step in-line quality control check at least once daily and upon changing to a new lot of material in order to ensure performance of both dispensing equipment and foam product prior to installing penetration seals. The four-step quality check includes evaluation for: snap time (cure rate); foam color and uniformity; foam cell structure; and foam density (weight).
2. Check cured penetration seal after 24-hour cure by removing damming materials to examine seal.
3. Cured foam should completely fill penetration. Fill all remaining gaps with freshly mixed foam or firestopping sealant.
4. Recheck after added material has cured 24 hours.
5. Damming materials required to achieve a fire rating must be returned to the penetration.
6. Clean up spills of liquid components with high-flash mineral spirit solvent, following manufacturer's instructions.
7. If necessary, trim excess cured foam with a sharp knife or blade.

#### B. Firestopping Sealant:

1. Check completed work for complete adhesion and seal 48 hours after sealant application.
2. Clean adjacent surfaces of excess sealant using a compatible solvent in accordance with the manufacturer's instructions.

END OF SECTION

## SECTION 07420

### ALUMINUM COMPOSITE PANELS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. The extent of panel system work is indicated on the drawings and in these specifications.
  - 2. Panel system requirements include the following components:
    - a. Aluminum-faced composite panels with mounting system. Panel mounting system including anchorages, furring, fasteners, gaskets and sealants, related flashing adapters and masking for a complete installation.
    - b. Panels shall include shop-installed aluminum stiffeners on all panels.
    - c. Soffit panels/fascia and side panels (at major overhang along east elevation of the structure) are integral components of the aluminum composite panel system as designed.
    - d. All flashing metal required shall be provided by the panel manufacturer.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Composite panel manufacturer shall have a minimum of 15 years' architectural experience in the manufacture of this product and be located within the continental USA.
- B. It is recommended that fabrication and installation of composite panels shall be from a single source. If not single source, both panel fabricator and the installer must show proof of past successful collaboration.
- C. Installer shall have a minimum 5 years' experience in architectural metal panel work similar in scope and size to this project.
- D. Shop drawings shall show the preferred joint details providing structurally sound wall panel system.
- E. Maximum deviation from vertical and horizontal alignment of erected panels: 6 mm (1/4 inch) in 6 m (20 feet) nonaccumulative.
- F. Panel fabricator and installer shall assume undivided responsibility for all components of the exterior panel system, including but not limited to, attachment to subconstruction, panel-to-panel joinery, panel-to-dissimilar-material joinery, and joint seal associated with the panel system.

## 1.03 REFERENCES

### A. ASTM

1. E330: Structural Performance of Exterior Windows, Curtain Walls, and Doors under the Influence of Wind Loads.
2. D1781: Climbing Drum Peel Test for Adhesive Materials.
3. E84: Surface-Burning Characteristics of Building Materials.
4. E283: Air Performance of Exterior Windows, Curtain Walls, and Doors.
5. D3363: Method for Film Hardness by Pencil Test.
6. D2794: Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
7. D3359: Methods for Measuring Adhesion by Tape Test.
8. D2247: Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
9. B117: Method of Salt Spray (Fog) Testing.
10. D822: Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer and Related Products.
11. D1308: Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
12. D1735: Method for Water Fog Testing of Organic Coatings.
13. D1929: Standard Test Method for Determining Ignition Temperature of Plastics.
14. D635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in Horizontal Position.

B. Underwriters Laboratories: UL 1715: Room Fire Test Standard for Interior of Foam Plastic Systems.

C. American Architectural Manufacturers Association: AAMA-620 Coil Coating Aluminum Substrates.

D. National Fire Protection Association: NFPA 285: Standard Method of Test for the Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components.

## 1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300–Submittals.

### B. Samples

1. Panel assembly: A sample of mounting brackets/clips to be used with panels.
2. Two samples of each color or finish selected, 76 mm (3 inches) x 102 mm (4 inches) minimum.

C. Shop Drawings: Submit shop drawings showing project layout and elevations; fastening and anchoring methods; detail and location of joints, sealants and gaskets, including joints necessary to accommodate thermal movement; trim; flashing; and accessories. Shop drawings shall indicate location and type of aluminum-extruded stiffeners at typical panels and side panels.

D. Submit documents that include evaluation reports, test reports, supporting document and drawings, and manufacturer's data.

## 1.05 WARRANTY

- A. CONTRACTOR will warrant the panel system for a period of one year that the fabrication and installation workmanship will be free from defects.
- B. The aluminum composite material manufacturer shall warrant for a period of 30 years against Max 5 fade based on ASTM D2244 and Max 8 chalk based on ASTM D4212 and delamination of the paint finish.

## 1.06 PACKAGING, SHIPPING, AND HANDLING

- A. CONTRACTOR shall follow manufacturer's handling recommendations.
- B. CONTRACTOR shall store material in accordance with panel manufacturer's recommendations.

## PART 2--PRODUCTS

### 2.01 PANELS

- A. Composite Panels:
  - 1. Panels shall be Reynobond<sup>®</sup> Fire Resistant (FR) Aluminum Composite Materials Reynobond<sup>®</sup> (ACM) as manufactured by Alcoa Architectural Products, 50 Industrial Boulevard, Eastman, Georgia 31023 (800-841-7774 or 478-374-4746 or at [www.alcoaarchitecturalproducts.com](http://www.alcoaarchitecturalproducts.com)), or equal.
  - 2. Panel shall be Fire Resistant Core (FR).
  - 3. Panel Thickness: RB160 (4 mm) = 0.157.
  - 4. Panel Weight: RB160 (4 mm) = 1.53 lbs/ft<sup>2</sup>.
- B. Product Performance:
  - 1. Bond integrity: When tested for bond integrity, in accordance with ASTM D1781 (simulating resistance to panel delamination), there shall not be an adhesive failure of the bond a) between the core and the skin or b) cohesive failure of the core itself below the following values.
  - 2. Peel Strength:
    - a. 22.5 in lb./in. as manufactured.
    - b. 22.5 in lb./in. after 21 days soaking in water at 70°F.
    - c. Fire Performance: ASTM E84—Passed Class A.
- C. Finishes:
  - 1. Alcoa Architectural Products shall be Colorweld<sup>®</sup> 500 a fluoropolymer coating utilizing 70% Kynar 500<sup>®</sup> resins.
  - 2. Color shall be Colorweld 500 Deep Black, or equal.
  - 3. Coating shall be factory applied on a continuous-process paint line. Colorweld<sup>®</sup> 500XL, coating shall consist of a 0.2 mil (approx.) barrier prime coat, a 0.80 mil (approx.) color coat, containing 70% Kynar 500<sup>®</sup> resins and a 0.5 mil (approx.) clear coat containing 70% Kynar 500<sup>®</sup> resins.) Nominal dry film thickness is 1.50 mils.
  - 4. Gloss shall be ASTM D523 standard at 60° shall be 25–30.
  - 5. Pencil hardness shall be ASTM D3363 shall be F-2H minimum.
  - 6. Flexibility T-Bend shall be ASTM D4145 shall be 0-2T-Bend; no pick-off.

7. Adhesion shall be ASTM D3359 reverse impact 1/16-inch crosshatch and shall show no cracking or adhesion loss.
8. Reverse impact shall be ASTM D2794 1500 x metal thickness aluminum and shall show no cracking or adhesion loss.
9. Acid resistance shall be ASTM D1308, 10% muriatic acid, 24 hours and shall show no effect, 20% sulfuric acid, 18 hours, and shall show no effect.
10. Acid rain test shall be Kesternich SO<sub>2</sub>, DIN 500180, 10 cycles min. No objectionable color change.
11. Alkali resistance shall be ASTM D1308, 10%, 25% NaOH, 1 hour and shall show no effect.
12. Salt spray resistance shall be ASTM B117, 5% salt fog at 95°F, pass 4,000 hours less than 1/16 inch average creep from scribe; up to a few #8 blisters.
13. Humidity resistance shall be ASTM D714 and ASTM D2247 100% relative humidity at 95°F, shall pass 4,000 hours, #8 blisters.
14. Exterior exposure shall be 10 years at 45 degrees, South Florida. ASTM D2244 shall be maximum 5 fade and ASTM D4214 shall be maximum 8 chalk.
15. Paint system shall meet the requirements of AAMA 620 specifications.
16. Paint system shall have more than 20 years of architectural field use.

## 2.02 PANEL FABRICATION

- A. Fire resistant ACM is comprised of two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process using no glues or adhesives between dissimilar materials. The core shall be free of voids and/or air spaces and not contain foamed insulation materials. The bond between the core and the skins shall be a chemical bond.
- B. Aluminum Face Sheets:
  1. Thickness shall be 0.028 inch.
  2. Aluminum alloy shall be 3000 series or equivalent.
- C. Tolerances:
  1. Panel bow shall not exceed 0.8% of panel overall dimension in width or length.
  2. Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible. Panel dimensions shall be such that there will be an allowance for field adjustment and thermal movement.
  3. Breaks and curves shall be sharp and true, and surfaces free of warps or buckles.
  4. Panels shall be visually flat.
- D. System Characteristics:
  1. Plans, elevations, details, characteristics, and other requirements indicated are based on standards by Reynobond.
  2. System must not generally have any visible fasteners, telegraphing, or fastening on the panel faces or any other compromise of a neat and flat appearance.
  3. Fabricate panel system to dimension, size, and profile indicated on the drawings based on a design temperature of 68°F (20°C).
  4. Fabricate panel system to avoid compressive skin stresses. The installation detailing shall be such that the panels remain flat regardless of temperature changes and at all times remain air- and watertight.

5. The finish side of the panel shall have a removable protective film applied prior to fabrication, which shall remain on the panel during fabrication, shipping, and erection to protect the surface from damage.
- E. Systems Type: Rout-and-Return Dry System: Fabricator and installer must provide an engineered pressure relief system including extruded perimeter frame; drainage gutter; all extrusions, clips, fasteners, anchors, spacers, trim, flashings, gaskets, and sealant.
  - F. System Performance: Composite panels shall be capable of withstanding building movements and weather exposures based on the following test standards required by the architect and/or local building codes:
    1. Wind Load: If system tests are not available, under the direction of an independent third-party laboratory, mockups shall be constructed and tests performed to show compliance to the following minimum standards:
      - a. Panels shall be designed to withstand the design wind load based on the local building code, but in no case less than 20 psf and 30 psf on parapet and corner panels. Wind-load testing shall be conducted in accordance with ASTM E330 to obtain the following results.
      - b. Normal to the plane of the wall between supports, deflection of the secured perimeter-framing members shall not exceed  $L/175$  or  $3/4$  inches, whichever is less.
      - c. Normal to the plane of the wall, the maximum panel deflection shall not exceed  $L/60$  of the full span.
      - d. Maximum anchor deflection shall not exceed  $1/16$  inch. At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed  $1/100$  of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed  $1/16$  inch.
    2. Air/Water System Test: Without backup waterproof membrane.
      - a. Air Infiltration: When tested in accordance with ASTM E283, air infiltration at 1.57 psf must not exceed 0.06 cubic feet per minute per square foot of wall area.
      - b. Water Infiltration: Water infiltration is defined as uncontrolled water leakage through the exterior face of the assembly. Systems not using a construction sealant at the panel joints (such as Dry Systems) shall be designed to drain any water leakage occurring at the joints. No water infiltration shall occur in any system under a differential static pressure of 6.24 psf after 15 minutes of exposure in accordance with ASTM E331.
      - c. The above tests are on panel systems that do not include a waterproof membrane behind panels.

## 2.03 ACCESSORIES

- A. Extrusions, formed members, sheet, and plate shall conform with ASTM B209 and the recommendations of the manufacturer.
- B. Panel stiffeners are required and shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.
- C. Sealants and gaskets within the panel system shall be according to manufacturer's standards to meet performance requirements.

- D. Fabricate flashing materials from 0.040 inch minimum thickness aluminum sheet provided by panel manufacturer to match the adjacent curtain wall/panel system where exposed. Post-painted spray-applied flashings are not acceptable. Provide a lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bead of nonhardening sealant.
- E. Fasteners (concealed/noncorrosive): Fasteners shall be as recommended by system fabricator and installer.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Surfaces to receive panels shall be even, smooth, sound, clean, dry, and free from defects. Panels shall be erected plumb and level.
- B. Attachment system shall allow for the free vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F (-29°C) to +180°F (+82°C). Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement are not permitted. Fabrication, assembly, and erection procedure shall account for the ambient temperature at the time of the respective operation.
- C. Panels shall be erected in accordance with an approved set of shop drawings.
- D. Anchor panels shall be secured according to manufacturer's recommendations and in accordance with approved shop drawings to allow for necessary thermal movement and structural support.
- E. Conform to panel fabricator's instructions for installation of concealed fasteners.
- F. Do not install component parts that are observed to be defective, including warped, bowed, dented, scraped, and broken members.
- G. Do not cut, trim, weld, or scrape component parts during erection in a manner that would damage the finish, decrease strength, or result in a visual imperfection or a failure in performance. Return component parts that require alteration to shop for refabrication or for replacement with new parts.
- H. Separate dissimilar metals; use appropriate gaskets and fasteners to minimize corrosive or electrolytic action between metals.

### 3.02 ADJUSTING AND CLEANING

- A. Remove and replace panels damaged beyond repair as a direct result of panel installation. After installation, panel repair and replacement shall become the responsibility of the CONTRACTOR.

- B. Remove masking film (if used) as soon as possible after installation. Masking intentionally left in place after panel installation on an elevation shall become the responsibility of the CONTRACTOR.
- C. Any additional protection, after installation, shall be the responsibility of the CONTRACTOR to remove.
- D. Make sure weep holes and drainage channels are unobstructed and free of dirt and sealants.

END OF SECTION

## SECTION 07460

### EXTRUDED GLASS FIBER CONCRETE PANEL RAINSCREEN CLADDING SYSTEM

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: The Work of this Section shall include but not be limited to the following:
  - 1. Aluminum support system.
  - 2. Extruded glass fiber concrete panels.
  - 3. Flashing, weather-seals, cover plates and formed metal trim.
  - 4. Miscellaneous anchors, fasteners, adhesives, insulation, vapor barrier, sealants, and related accessories.
- B. Related Sections: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 DEFINITIONS

- A. Rainscreen Principle: Method for controlling rain penetration through wall cladding system. Open joints allow air pressure in cavity behind cladding to equal outside air pressure thus resisting wind driven rain. Rainscreen system includes:
  - 1. Drained and vented wall cladding.
  - 2. Air barrier on cladding substrate (as provided for in Section 07191-Vapor and Air Barriers).
  - 3. Subdivision of cavity behind cladding into sealed compartments.
  - 4. Flashings and weep holes to drain water from cavity.

##### 1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Design and install fibre concrete cladding and attachment system to provide in conjunction with wall substrate and air barrier a weather-tight wall assembly utilizing rain screen principle.
- B. System Design: System design shall be responsibility of cladding supplier. Products provided must conform with design intent shown.
- C. Panel System: Rear Ventilated Rain Screen Design. System shall drain water and condensation to exterior. A complete preengineered system including, but not limited to, glass fibre concrete cladding, aluminum metal support structure, closure pieces, trim and flashing. Wall panels shall be removable. Fasteners are exposed. The panels shall be secured to an aluminum metal support structure which secures to cold-formed metal framing. Spacing of cold-formed metal framing indicated on structural drawings shall not be greater than 16 inches o.c. Aluminum metal support structure shall also be of multiple components, with one component attaching to structure over the air barrier (using an attachment bracket) and one component fastening to bracket horizontally to allow for attachment of composite panels. Membrane should be visually inspected for breaches (and repaired as recommended by membrane manufacturer) prior to installation of support system.

- D. Joints shall be dry and uncaulked.
- E. Metal Flashing:
  - 1. Provide metal flashing for a proper water managed assembly, to direct condensation and water infiltration within the wall to weeping points. Coordinate details and installation with water and air barrier provided with Section 07191-Vapor and Air Barrier. All flashing and ventilation profiles shall be provided by installer per manufacturer's recommendations (sizes and locations).
  - 2. Drainage flashing is the primary component of a water managed system which diverts water that has penetrated the exterior cladding away from the cladding compartment or condensation that occurs at the interior face of cladding surface
  - 3. Provide metal drainage flashing at locations listed below prior to installation of membrane to assure proper water drainage. Membrane shall assure proper lap over flashing:
    - a. At bottom of system.
    - b. At penetrations: Windows, doors, louvers, etc.
    - c. At floor line or other locations which accommodate vertical movement.
    - d. End Dams: provide shop-formed end dams where drainage flashing terminates at openings.
      - (1) Configuration shall be triangular shaped, full width of horizontal flashing leg by 1 inch high.
      - (2) Attachment: Solder joints and miters for an air and water tight condition.
- F. Design Modifications shall be provided only as necessary to satisfy as built conditions and to meet performance requirements.
- G. CONTRACTOR shall be responsible for engineering system per architectural design criteria and performance requirements.

#### 1.04 PERFORMANCE REQUIREMENTS

- A. Withstand design loads as follows:
  - 1. Maximum panel deflection: 1/360 of span or less of span when tested in accordance with positive and negative pressures and as required to prevent cracking or damage to panel facing.
  - 2. Comply with applicable seismic requirements for Project location in Seismic Design Category B as defined by Wisconsin Commercial Building Code.
  - 3. System shall have a design load of positive and negative pressures up to 40 psf in accordance with ASTM E330.
- B. Accommodate movement of cladding components without undue stress on fasteners or other detrimental effects, when subjected to seasonal temperature range of:
  - 1. Ambient: 120°F.
  - 2. Cladding surface: 180°F.
- C. Accommodate tolerances of support structure:
  - 1. Condensation: System shall accommodate positive drainage for moisture entering or condensation occurring within panel system.
  - 2. Design drainage system for 100-year rain cycle: Flatness: System shall be flat with no noticeable warpage, buckling, deflections or other surface irregularities.

## 1.05 SUBMITTALS

- A. See Section 01300–Submittals for general submittal requirements.
- B. Product data describing materials and fabrication for glass fiber concrete panels.
- C. Product data describing materials and fabrication for aluminum attachment system and components.
- D. Shop drawings showing:
  - 1. Layout, profiles and dimensions for panels, product components, edge conditions, special shapes, and trim pieces.
  - 2. Installation details: Attachment methods, fasteners, joints, corners, openings, intersections with adjacent materials, flashings, closures, trim, and other critical conditions.
  - 3. Layout of glass fiber concrete panels on wall and locations of special pieces and trim.
- E. Structural calculations signed and sealed by a professional engineer registered in the State of Wisconsin.
- F. Samples (3 sets each):
  - 1. 3 1/2 inches by 5-inch minimum color samples for review by Architect.
  - 2. 4 inches minimum length of attachment profile.
  - 3. Typical attachment brackets and anchors.
  - 4. Typical exposed fasteners (painted to match concrete panel).
- G. Manufacturer's installation and maintenance instructions.

## 1.06 QUALITY ASSURANCE

- A. System Manufacturer's Qualifications: Provide exterior wall system manufactured by a firm experienced in manufacturing systems that are similar to those indicated for this project and have a record of 5 years of successful in-service performance.
- B. Installer Qualifications: Company with experience in installing exterior wall cladding systems and acceptable to glass fiber concrete panel and aluminum support system suppliers. Provide written verification from system manufacturer.
- C. Prior to installation of cladding, membrane suppliers field representative shall inspect wall substrate and air barrier to confirm proper installation and submit a report of observations and findings to the Architect.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prior to shipping, pack and crate glass fiber concrete panel system components to prevent damage during transit and storage. During transport, handle the panels with special care taken not to damage the edges of the sheets.
- B. Inspect fiber concrete cladding panels and aluminum attachment components immediately upon delivery at site. Notify manufacturer of damage prior to installation of materials.

- C. Follow manufacturer's instructions for storage of glass fiber concrete panels. Keep pieces in original packing material until ready to install.
- D. Do not store exterior wall system components in contact with other materials that might cause staining, denting, surface damage, or other deleterious effects.

#### 1.08 WARRANTY

- A. Warrant the glass fiber concrete panel of this section for a period of 20 years from the date of substantial completion against defects in material.
- B. Warrant the workmanship for this Section for a period of 2 years from the date of substantial completion against defects in the workmanship.

### PART 2--PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, manufacturer of exterior wall panels for Glass fiber concrete cladding rain screen system is: Basis of Cladding Design: Fibre C extruded glass fibre concrete skin.
  - 1. Manufactured by Reider Smart Elements, [www.rieder.cc](http://www.rieder.cc).
  - 2. Local contact: Hughes & Associates Inc., 847-991-8910, [www.UseHughes.com](http://www.UseHughes.com).

#### 2.02 MATERIALS

- A. Panels:
  - 1. Fibre C extruded, fibre reinforced concrete panel, or equal.
  - 2. Panels: Glass fibre concrete panels made from pure mineral raw materials, (sand cement, water). Reinforced through AR ( alkali-resistant) glass fibres as continuous linear glass fibre strands and short fibres in matrix.
  - 3. Color: Anthracite.
  - 4. Surface types:
    - a. MA-Matt surface.
    - b. FL-Ferro light/sand blasted surface, or as noted on plans.
  - 5. Surface: Hydrophobic matt.
  - 6. 1/2-inch (13 mm) thickness: Size as required:
    - a. 47 5/8 inches by 8 feet 2 27/64 inches (1210 mm by 2500 mm).
    - b. 47 5/8 inches by 11 feet 9 3/4 inches (1210 by 3600 mm).
  - 7. Dimensional Tolerances: Length +/- mm, Width +/- mm, Thickness +/- mm.
- B. Aluminum Support Structure—Complete Extruded Aluminum subframe assembly.
  - 1. Horizontally-oriented concealed fastener attachment system Support Bracket: Angle bracket anchored directly through wall substrate into support framing.
  - 2. Horizontal L Profile shelf shimming extrusions that fastens into open end of support bracket and supports.
  - 3. Vertical support rails: Aluminum U- and Z-shaped rails attached to L Profile which provide means to suspend glass fiber concrete panels. Concealed fasteners attach directly to vertical support rail.
  - 4. Fasteners: Corrosion-resistant stainless steel fasteners and anchors of type, size, and spacing required for type of substrate and Project conditions, to meet

performance requirements specified in Paragraph 1.04, and as indicated in design calculations.

- C. Sheet Metal: Provide sheet metal flashings and trim as required for cladding system in accordance with Section 07620–Flashing and Sheet Metal.
  - 1. Shop form components to profiles, dimensions, and thicknesses indicated on Drawings. Items to be provided include:
    - a. Cavity drainage flashings: Aluminum flashing at bottom of air cavities and pressurized compartments to gravity drain water from cavity.
    - b. Flashing joint profiles at horizontal joint conditions Formed profiles fabricated and installed to shed water within horizontal joint condition (noncontinuous, interrupted at vertical U profile).
  - 2. Window sills and transition pieces to adjacent materials and other exposed trim: Aluminum fabrications with mill aluminum finish. Attach with clips or other means to avoid exposed fasteners.
  - 3. Form sheet metal fabrications in longest possible lengths. Turn back all exposed edges to form hem. Fabricate vertical faces with bottom edge formed outward and hemmed to provide drip.

### PART 3–EXECUTION

#### 3.01 INSPECTION

- A. Examine walls to receive cladding system. Ensure substrate is structurally sound, clean, and free of contaminants which inhibit bond of air barrier.
- B. Factory-trained employees Fibre C to inspect and certify the following:
  - 1. Original signed certificates, approving all aspects of construction to be delivered to OWNER.
  - 2. Inspection of the project at the 35% to 50% construction stage.
  - 3. Maximum substrate deflection:  $L/360$  or as recommended by cladding systems manufacturers.
  - 4. Maximum substrate surface variation: 1/8 inch in 10 feet.
  - 5. Stud construction with [gypsum sheathing] [cementitious backer board] [exterior grade plywood]: Verify stud framing is adequately braced without deflection and sheathing is properly secured with edges over firm bearing. Ensure proper framing and supports are provided and located for secure attachment of support rails.
- C. Do not proceed with cladding installation until deficiencies have been addressed.

#### 3.02 PREPARATION

- A. Install assembly of thermal insulation, furring, and sheathing on drawings and approved shop drawings.
- B. Air Barrier: Install air barrier to wall sheathing detailed on drawings and approved shop drawings. Install horizontally starting at bottom of wall. Do not leave air barrier membrane exposed for lengthy period of time. Exercise care not to puncture or tear barrier with subsequent cladding operations.

- C. Flashings: Install sheet metal flashings, pressure compartment dividers and trim. Ensure flashings at bottom of wall and pressure compartments properly drain water from air cavity to exterior through weep holes. Turn up flashings 4 inches minimum and seal to substrate. Lap flashing end joints 6 inches and seal watertight.

### 3.03 CLADDING INSTALLATION

- A. Install cladding in accordance with manufacturer's instructions and approved shop drawings.
- B. Establish level lines for panel coursing and positioning of support rails.
- C. Support Rails: Attach horizontal rails with engineered fasteners and anchors to accomplish performance requirements specified in Paragraph 1.04.
  - 1. Attach rails to substrate at 24 inches or at a distance as recommended by system suppliers in accordance with lateral loads and system dead load requirements.
  - 2. Provide 1 to 2 inches of space between ends of adjacent rails for expansion and contraction of aluminum.
- D. Glass Fiber Concrete Panels: Starting at bottom of wall, fasten panels by fastening into vertical aluminum profile at location of predrilled holes in glass fiber concrete panels.
  - 1. Layout work so as to avoid or minimize cuts. Site cut composite wood panels using power saw with appropriate blade type to prevent broken corners, edges, and chips.
  - 2. See drawing for joint pattern. Install panels with continuous horizontal joints (unless otherwise noted on drawings). Vertical and horizontal joints shall be open approximately 3/16 inch [5 mm] wide.
  - 3. Tolerances:
    - a. Shim and align composite panels to provide these tolerances.
    - b. Deviations from level or plumb alignment: 1/4 inch in 20 feet maximum, nonaccumulative.

### 3.04 CLEANING AND PROTECTION

- A. Remove and replace broken, chipped, stained, or otherwise damaged panels.
- B. Immediately after installing, wipe down work. Do not use wire brushes, metallic tools, or abrasives for cleaning.
- C. Protect cladding from roof runoff, splashed water, mud, sealants, bitumen, and other contaminants from remaining construction activities.
- D. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION

## SECTION 07531

### SINGLE-PLY ROOFING–FULLY ADHERED

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Vapor retarder.
  - 2. Rigid roof insulation.
  - 3. Protection board.
  - 4. Membrane roofing and related accessories.
  - 5. See drawings for locations of adhered roofing.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. FM 4470 (Factory Mutual Engineering Corporation)–Roof Assembly Classifications.
- B. NRCA (National Roofing Contractors' Association)–Roofing and Waterproofing Manual.
- C. UL 790–Fire Hazard Classifications.

##### 1.03 SUBMITTALS

- A. See Section 01300–Submittals for general submittal requirements.
- B. Submit the following:
  - 1. Tapered insulation layout plan.
  - 2. Roofing layout plan.
  - 3. Flashing, joint, and termination details.
  - 4. Product data for all products specified in this section.
  - 5. Manufacturer's installation instructions.
  - 6. Copy of system warranty.

##### 1.04 QUALITY ASSURANCE

- A. The roofing system must achieve a UL Class B.
- B. The membrane must be manufactured by the material supplier. Manufacturer's supplying membrane made by others are not acceptable.
- C. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.
- D. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least 5 years successful experience installing single-ply roofing

systems and having installed at least one roofing application or several similar systems of equal or greater size within one year.

- E. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and an experienced superintendent on the job at all times roofing work is in progress.
- F. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the building owner seventy-two (72) hours prior to the manufacturer's final inspection.

#### 1.05 QUALIFICATIONS OF INSTALLER

- A. Roofing system shall be installed by a manufacturer-authorized roofing applicator who is thoroughly familiar with the system, and has extensive experience in performing the work of this section.

#### 1.06 WARRANTY

- A. Furnish to OWNER the roofing manufacturer's 15-year total system warranty covering the costs of all labor and materials required to repair any leaks and any defects in the roofing system. All products and applications required by the roof manufacturer to obtain the warranty shall be included in the Bid. OWNER will not pay for the roofing system unless the warranty is issued by the manufacturer.

### PART 2--PRODUCTS

#### 2.01 VAPOR RETARDER

- A. Vapor retarder shall be a 3-ply laminate combining two layers of fire retardant linear low density polyethylene and a high-strength cord grid. Vapor retarder shall conform to UL construction No. 1 fire-resistance requirements.
- B. Vapor retarder shall be approved by roofing manufacturer for use in the roofing system. Unless prohibited by the roofing manufacturer, acceptable products include the following, or equal: Griffolyn Tx-1200 FR by Reef Industries.

#### 2.02 ROOF INSULATION

- A. Roof insulation shall be polyurethane tapered board insulation. Minimum thickness shall be 2 inch at roof drains. Aged thermal resistance (R-value) at 75°F shall be a minimum of 6.0 per inch of thickness.
- B. Slope of tapered insulation shall be as shown on the drawings, but shall not be less than the minimum slope required by the roofing manufacturer.
- C. Roof insulation shall be approved by roofing manufacturer for use in the roofing system.

## 2.03 PROTECTION BOARD

- A. Protection board shall be minimum 1/2-inch structural wood fiberboard approved by the roofing manufacturer for use in this system.

## 2.04 MEMBRANE, FLASHING, AND ACCESSORIES

- A. Roofing membrane shall be nonreinforced EPDM, 0.060 inches thick.
- B. Acceptable systems include the following, or equal:
  - 1. Sure Seal, Design A Adhered System by Carlise SynTec Systems, Division of Carlise Corporation.
  - 2. Rubberguard Adhered System by Firestone Building Products Company.
- C. Flashing shall be minimum 0.060-inch-thick neoprene or EPDM sheet flashing provided by the roofing manufacturer. All adhesives, sealants, splicing tape, fastening strips, fasteners, pipe flashing boots, walkway pads, and all accessories necessary to complete the system shall be provided by the roofing manufacturer.
- D. Provide precast concrete splash pads at all new roof drain downspouts. Splash pads shall be of 3,000 psi concrete.

## PART 3—EXECUTION

### 3.01 SURFACE PREPARATION

- A. Surfaces on which the roofing system is to be applied shall be clean, smooth, dry, and free of fins, sharp edges, loose and foreign materials, oil, grease, and all contaminants that would be detrimental to the bonding of the roof system. The condition of the roof deck shall be approved by the roofing manufacturer before the membrane is applied.

### 3.02 INSTALLATION

- A. Wood nailers shall be provided around all roof projections and penetrations except drains, as required by the roof manufacturer. Wood nailers shall be in accordance with Section 06114—Wood Blocking and Curbing. Height of nailers shall be matched to the thickness of the insulation being used. Nailers shall be firmly anchored to the deck to resist a force of 200 pounds per linear foot. A minimum of three anchors shall be used to anchor each length of nailer, with 1/2-inch vent left between length of nailers. Provide approved nailing strip at perimeter of roof.
- B. The thermal insulation and fiberboard shall be anchored to the concrete deck with fasteners approved by the roofing manufacturer. The insulation shall be neatly cut to fit around all roof penetrations and projections. Any other requirements of the roofing manufacturer shall be complied with. Slope of roof insulation shall be as shown on the drawings, but in no case shall be less than the minimum slope required by the roofing manufacturer.
- C. The roofing membrane and accessories shall be furnished and installed in accordance with manufacturers' recommendations. Lap adjacent sheets a minimum of 3 inches. Seams shall be sealed with splicing cement. A bead of lap sealant shall be applied to completely cover the splice edge providing a second independent seam seal. All seams shall be taped

with an approved seam tape and installed in accordance with manufacturer's recommendations.

- D. Flashing shall be provided at all vertical surfaces, roof interruptions, and penetrations in accordance with membrane manufacturer's recommendations and Contract Documents. All flashings and terminations shall be securely fastened in the plane of the roof deck with fasteners recommended by the system manufacturer. Membrane edges or flashing shall be mechanically fastened to the nailer at maximum of 8-inch centers.
- E. No unit having defects shall be installed. In no event shall more insulation be placed on the surface to be roofed than can be covered with roofing membrane prior to the onset of inclement weather or termination of the day's work. Water must not be allowed beneath any completed section of roof. Temporary water cutoffs may be made by extending the membrane beyond the insulation and setting the end of the membrane in a sealant. All water cutoffs shall be removed prior to proceeding with the next day's work.

END OF SECTION

## SECTION 07565

### PREPARATION FOR REROOFING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes removal of existing roofing system on buildings as noted on the drawings in preparation for installation of a new membrane roofing system.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REGULATORY REQUIREMENTS

- A. CONTRACTOR shall properly dispose of roofing in accordance with all local, state, and federal regulations.

##### 1.03 ENVIRONMENTAL REQUIREMENTS

- A. Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.
- B. Maintain continuous temporary protection prior to and during installation of the new roofing system.

#### PART 2–PRODUCTS

##### 2.01 TEMPORARY PROTECTION MATERIALS

- A. Provide polyethylene sheeting or other materials required to provide temporary protection in accordance with Section 1.03.B.

#### PART 3–EXECUTION

##### 3.01 PREPARATION

- A. All roof-mounted equipment and appurtenances shall be removed and reinstalled as part of this work.
- B. All roofing, insulation, and nailers as shown on drawings shall be removed and disposed of by CONTRACTOR.

END OF SECTION

## SECTION 07620

### FLASHING AND SHEET METAL

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes masonry wall flashing, custom fabricated sheet metal flashing, and counter flashing at: Eave, gable, and ridge lines; parapet walls; scuppers; roof hatches; roof-mounted equipment; vent stacks; and other locations.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A653—Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- B. ASTM A924—General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
- C. ASTM B32—Solder Metal.
- D. ASTM B209—Aluminum and Alloy Sheet and Plate.
- E. ASTM D4586—Asphalt Roof Cement, Asbestos-Free.
- F. SMACNA—Architectural Sheet Metal Manual.

##### 1.03 SUBMITTALS

- A. See Section 01300—Submittals for general submittal requirements.
- B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.

##### 1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details and requirements.

##### 1.05 QUALIFICATIONS

- A. Fabricator and installer shall be a company specializing in sheet metal fabrication work with a minimum of five years of verifiable experience in that field.

##### 1.06 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

## PART 2—PRODUCTS

### 2.01 MATERIALS

- A. Masonry wall flashing and flashing around windows, doors, and other openings shall be 32 mil of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane. Flashing shall be PERM-A-BARRIER wall flashing as manufactured by Grace Construction Products, or equal. Provide primer or surface conditioner as recommended by manufacturer.
- B. Galvanized steel sheet: 26-gauge meeting ASTM A525, Grade A with G90 zinc coating.
- C. Aluminum sheet: 0.032-inch-thick meeting ASTM B209.
- D. Fasteners: Same material and finish as flashing sheet. Stainless steel fasteners may be used with any flashing material. Provide soft neoprene washers with fasteners.
- E. Primer: Zinc chromate type.
- F. Protective Backing Paint: Bituminous type.
- G. Sealant: See Section 07900—Caulking and Sealants.
- H. Bedding Compound: Rubber asphalt or butyl type.
- I. Plastic Cement: ASTM D4586, Type I or II.
- J. Reglets: Galvanized steel or PVC, surface-mounted or recessed, or as shown on the drawings.
- K. Solder: ASTM B32. Soldering is not permitted on aluminum or stainless steel sheet.

### 2.02 FABRICATION

- A. All flashing and fascia shall be formed to the configurations shown on the drawings and/or the applicable manufacturer's details, or in accordance with SMACNA standard details where not shown on the drawings or in manufacturers details. Form sections true to shape, accurate in size, square, and free from buckles, kinks, or other defects.
- B. All exposed edges shall be folded or returned on themselves at least 1/2-inch. Corners shall be mitered and seamed.
- C. Form pieces in the longest possible lengths. Form material with flat lock seams.
- D. All sections shall be provided with slip joints at 8 feet on center.
- E. Cleats shall be fabricated of the same materials as the flashing sheets and shall be interlockable with the sheets.

- F. Fabricate vertical faces with bottom edge formed outward 1/4-inch and hemmed to form a drip.
- G. Fabricate corners from one piece with minimum 18-inch-long legs. Seam or solder for rigidity and seal with sealant.

### 2.03 FINISH

- A. Back paint all sheet metal with asphaltum paint where sheet metal surfaces come in contact with masonry or steel.
- B. Flashing and fascia shall be painted where exposed to view from the ground. Galvanized steel shall be painted in accordance with Section 09900–Painting. Aluminum shall be coated with a Kynar 500 coating system.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Through-wall flashing shall be installed 1/2-inch back of the outside face of the wall, carried through the outside wythe, turned up in the collar, and adhered to back-up wall as shown on the drawings. At no time should any portion of the flashing be allowed to hang or drape beyond the width of the wall. All laps shall be sealed and shall not be less than 3 inches in width. Flashing around openings shall extend at least 3 inches beyond each side of opening.
- B. Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and line accurate to profiles. Seal metal joints watertight.
- C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted by ENGINEER.
- D. Insert flashings into reglets where shown on the drawings. Seal flashings into reglets with sealant.
- E. Counter flashing shall be provided at all vertical masonry and/or concrete walls which extend above the roof line. The counter flashing shall be installed in a reglet unless otherwise shown. Surface-mounted reglets shall be used where noted.
- F. CONTRACTOR shall provide copper sleeves for hot pipes penetrating the roof as approved by the roofing manufacturer. The annular space between the sleeve and the pipe shall be packed with insulation capable of withstanding the maximum temperature of the pipe. CONTRACTOR to provide a galvanized steel rain collar welded to the hot pipe.

END OF SECTION

## SECTION 07710

### MANUFACTURED ROOF SPECIALTIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Metal fascia.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. SMACNA—Architectural Sheet Metal Manual.

##### 1.03 SUBMITTALS

- A. Submittals shall comply with requirements of Section 01300—Submittals.
- B. Submit sample panels for selection of anodized or Kynar 500 finish colors.

##### 1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details.

##### 1.05 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

#### PART 2—PRODUCTS

##### 2.01 METAL FASCIA

- A. Metal fascia shall consist of a 24 gauge steel fascia with a face height of 6 3/4 inches and a continuous 22 gauge galvanized steel spring clip. Provide prefabricated mitered corners, splice sections, and all accessories for a complete weathertight installation.
- B. Acceptable products include the following, or equal:
  - 1. Econosnap by W.P. Hickman Company.
  - 2. PAC-LOC-Fascia by Peterson Aluminum Corporation.

##### 2.02 FINISHES

- A. Finish on all products shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500 fluoropolymer coating over an epoxy prime coat. Colors shall be selected by OWNER. All exposed fasteners shall be provided with the same finish as the sheet metal products.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install components in accordance with the drawings and the manufacturer's instructions.
- B. Installation details shall be such as to allow for thermal expansion and contraction of the components and to provide for a complete weatherproof installation.

END OF SECTION

## SECTION 07724

### ROOF HATCHES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes prefabricated roof hatches with integral support curb and operable hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 ROOF HATCHES

- A. Roof hatches shall consist of the following: a 12-inch-high, 11 gauge insulated aluminum curb with integral cap flashing of same material and thickness; an insulated cover with 11 gauge aluminum exterior liner and 18 gauge aluminum interior liner; hinges, compression spring operators, latches, and other associated hardware. All hardware should be stainless steel. Provide fully enclosed curb with custom apron at reservoir roof hatches.
- B. Roof hatches at reservoir shall have exterior aluminum or stainless steel padlock hasp.
- C. Acceptable manufacturers include the following, or equal: Bilco Company.

##### 2.02 ACCESSORIES

- A. Provide Bilco Ladder-up, or equal, at all roof hatches which have a ladder access. Materials and finish shall be 304 stainless steel.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION

- A. Install roof hatches in accordance with manufacturer's recommendations and Contract drawings. Coordinate installation with roofing work of this division.

##### 3.02 SCHEDULE

- A. The roof hatches are scheduled in the Door Schedule on the drawings.

END OF SECTION

## SECTION 07900

### 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 1 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 01300–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 weather-tight and guaranteed watertight by installer for two years from date of final payment. Deliver original guarantee to OWNER with copies to ENGINEER.
- B. Provide manufacturer's standard five-year product warranty.

#### 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. NP1 BASF Construction Chemicals, LLC.
  - 2. Vulkem 116 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 BASF Construction Chemicals, LLC.
  - 2. Vulkem 45 SSL by Tremco, Inc.

#### 2.03 CAULK-SUBMERGED APPLICATIONS-POTABLE WATER CONTACT

- A. Caulk in all submerged potable water contact applications shall be an NSF-approved two-part polysulfide base synthetic rubber sealant or an NSF-approved one-part polyurethane sealant recommended by the sealant manufacturer for potable water contact.
- B. Acceptable products include the following, or equal: Sika Duoflex NS, or 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 weather-tight 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-inch 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 weather-tight condition.

### 3.02 CAULKING EXISTING JOINTS

- A. All caulked joints in walls, ceilings, and floors requiring painting in the Room Finish Schedule (see drawings) shall be recaulked. Existing caulk and backer shall be completely removed. Caulk joints as specified for new construction.
- B. Caulking of existing joints shall be coordinated with Section 09900–Painting.

END OF SECTION

## SECTION 08220

### FIBERGLASS DOORS AND ALUMINUM FRAMES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes thermally insulated fiberglass doors and aluminum frames.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 WARRANTY

- A. Provide 10-year warranty on doors and frames signed by manufacturer, installer, and contractor.

#### PART 2—PRODUCTS

##### 2.01 FIBERGLASS DOORS

- A. Thermally insulated fiberglass doors shall be 1 3/4-inch total thickness with a 1 1/2-inch rigid polyurethane core.
- B. Acceptable products include the following, or equal: Special-Lite, Inc., SL-17.

##### 2.02 DOOR FRAMES

- A. Frames shall have 4-inch head member at 7-foot 0-inch doors in masonry walls.
- B. Aluminum frames shall be tube type, minimum 0.125-inch-thick.

##### 2.03 ARCHITECTURAL PANELS

- A. Architectural panels shall be 1 3/4 inch thick SL-37 panels with SpecLite3 FRP face sheets and construction to match doors.

##### 2.04 FABRICATION

- A. Face sheets shall be laminated to the polyurethane core. Face sheets shall be 0.120-inch-thick reinforced polyester. Face sheets shall be Spec Lite 3, Inc. as manufactured by Special-Lite, Inc.
- B. Stiles and rails shall be minimum 2 5/16-inch depth by 0.125-inch-thick aluminum, 6063-T5 aluminum alloy.
- C. All doors shall be mortised and reinforced to receive hardware.
- D. Frames shall be prepared for all door hardware.

- E. Door lites shall be factory installed and glazed prior to shipment. See Section 08800–Glazing, for lites.

## 2.05 FINISH

- A. Color of fiberglass door face sheets shall be chosen by OWNER from manufacturer's nine standard molded through colors. Aluminum frames and door extrusions shall have a Kynar® two-coat finish chosen from manufacturer's standard, 20 color. Color as chosen by OWNER.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Set all doors and frames as supplied by manufacturer. Use masonry anchors to support frame.
- B. Hang all doors allowing for expansion and contraction at time of setting.
- C. Set all hardware in accordance with templates as supplied by hardware supplier.
- D. Cover all exposed hardware until completion of painting and finishing.
- E. Examine hardware at completion; test, oil, grease, and adjust for perfect operation.

### 3.02 SCHEDULE

- A. See Door Schedule on the drawings.

END OF SECTION

## SECTION 08505

### STEEL WINDOWS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes fire rated steel window assemblies.

##### 1.02 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A569	(1991a; R 1993) Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A653	(1994) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B633	(1985; R 1994) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM B766	(1986; R 1993) Electrodeposited Coatings of Cadmium
ASTM E163	Fire Tests of Window Assemblies

#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts
ASME B18.6.4	(1981; R 1991) Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series)

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1992) Fire Doors and Windows
---------	-------------------------------

#### UNDERWRITERS LABORATORIES INC.

UL9	Fire Tests of Window Assemblies
File No. R13157	D.V. Fyre-Tec Classification

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Steel windows shall be designed to meet the following performance requirements, and shall be of the type and size indicated. Fire-rated windows shall bear the Underwriters Laboratories, Inc. label including the manufacturer's file number for the indicated rating.

- B. Fire Resistance:
  - 1. Fire resistance shall meet requirements established by ASTM E 163 and as tested and classified by Underwriters Laboratories Inc, in accordance with UL-9. Products shall meet the requirements of Underwriters Laboratories Inc. The Listing Mark of UL on the product will be accepted as evidence of compliance.
  - 2. Rated protected openings specified as 3/4-hour shall be glazed with rated wire glass

#### 1.04 SUBMITTALS

- A. Manufacturer's descriptive data and catalog cut sheets.
- B. Drawings indicating elevations of windows, rough-opening dimensions for each type and size of windows, full-size sections, thickness of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details and window schedules showing locations of each window type and indicating compliance with fire safety code, where required.
- C. Manufacturer's preprinted installation instructions and cleaning instructions.
- D. Certificates stating that the steel windows conform to requirements of this section.
- E. Manufacturer's standard color samples of painted finishes.

#### 1.05 DELIVERY AND STORAGE

- A. Steel windows shall be delivered to project site and stored in accordance with manufacturer's recommendations.

### PART 2-PRODUCTS

#### 2.01 GENERAL

- A. Manufacturer: Series 950 Fixed Lite Window as manufactured by D.V. Fyre-Tec, Wayne, NE 68787 (800-377-3261), or equal.

#### 2.02 MATERIALS

- A. Steel Frames: Steel frames shall be fabricated from roll-formed galvanized lock-forming quality steel per ASTM A527. Frame corners shall mitered and welded. Integral munton shall be galvanized roll-formed material fitted and welded.
- B. Formed Component Parts: Formed component parts shall be hot-rolled sheet steel conforming to ASTM A569, commercial quality with a minimum of 0.15 percent carbon. Sheet steel shall be zinc coated (galvanized) by the hot-dip process in accordance with ASTM A653 or ASTM A924.
- C. Screws and Bolts: Screws and bolts shall conform to ASTM B766, ASME B18.6.3 and ASME B18.6.4.

## 2.03 STEEL WINDOW TYPES

- A. Units shall be complete with glass and glazing provisions to meet requirements of Paragraph 1.03. Glazing material shall be compatible with steel, and shall not require painting.
- B. Fire-Rated Windows: Fire-rated windows shall conform to UL-9 and shall be labeled with a 3/4-hour fire-test rating as specified herein. Units shall be designed and fabricated to meet glass sizes, window sizes, and opening dimensions established by NFPA 80. Hardware shall conform to NFPA 80 requirements.

## 2.04 ACCESSORIES

- A. Fasteners: Fastening devices shall be window manufacturer's design made from nonmagnetic stainless steel, cadmium-plated steel, zinc-plated steel, nickel/chrome-plated steel or magnetic stainless steel
- B. Window Anchors: Anchors for installing windows shall be stainless steel or hot-dip zinc-coated steel conforming to ASTM A 123.

## 2.05 FINISHES

- A. Prime Coat: Steel windows, fins, mullions, cover plates and associated parts shall be cleaned, pretreated with iron phosphate and factory painted manufacturer's standard primer coat in a dry film thickness of not less than 0.025 mm (1.0 mil).
- B. Finish Coat: Steel windows, fins, mullions, cover plates and associated parts shall be cleaned, pretreated with iron phosphate and factory coated with baked alkyd enamel with a manufacturer's standard color in a dry film thickness of not less than 0.050 mm (2.0 mil).

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Steel windows shall be installed in accordance with approved shop drawings and manufacturer's approved recommendations. Fire-rated windows shall be installed in compliance with NFPA 80. Steel surfaces in close proximity with masonry, concrete, wood, and dissimilar metals other than stainless steel, zinc, cadmium, or small areas of white bronze shall be protected from direct contact. The completed window installation shall be watertight. Fire-rated windows shall be glazed in accordance with NFPA 80.

### 3.02 CLEANING

- A. Steel window finish and glass shall be cleaned on interior and exterior sides in accordance with window manufacturer's recommendation. Alkaline or abrasive agents shall not be used.

3.03 SCHEDULE

- A. See drawings for window information.

END OF SECTION

SECTION 08710  
DOOR HARDWARE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Hardware to fully equip all doors.
  - 2. Thresholds and weatherstripping.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. NFPA 80–Fire Doors and Windows.

1.03 REGULATORY REQUIREMENTS

- A. Hardware shall conform to the Wisconsin Commercial Building Code for requirements applicable to fire-rated doors and frames. Hardware shall comply with NFPA 80 and shall be properly stamped or labeled for easy identification.
- B. Hardware shall comply with barrier-free requirements.

PART 2–PRODUCTS

2.01 LOCKS AND LATCHES

- A. Locks, latches, and dead locks shall be Sargent cylindrical key-in-lever locks Series 10L, or equal, with 2 3/4-inch backset. Strikes shall be curved lip. Lockset and latchset numbers specified in paragraph 3.02 are Sargent. Provide removable core brass 6 cylinders.

2.02 EXIT DEVICES

- A. Exit devices shall be VonDuprin 9925 Series, or equal, and shall be equipped with reinforced cross bars and functions as indicated on the hardware sets. The exit device shall be operated by a mortised lockable lever from the exterior side.

2.03 HINGES

- A. Butt hinges shall be Stanley FBB 191, Hager BB 1191, or equal, full mortise, ball bearing, nonferrous, nonrising, loose pin, flat bottom tip, unless otherwise specified. Provide three 4 1/2-inch by 4 1/2-inch butts per door for doors 7 feet or less in height with one additional butt for each additional 30 inches or fraction thereof, unless otherwise specified. Provide additional butt or heavy-weight hinges for all doors that are over 36 inches wide, unless specified otherwise.

## 2.04 CLOSERS

- A. Door closers shall be LCN Series 1460 or equal. Provide aluminum finish on closers. Provide full covers. Door closers for locations noted as (ss) shall have the SRI primer for corrosion resistance. Door closers specified in paragraph 3.02 are LCN (H-Hold Open).

## 2.05 OVERHEAD HOLDERS

- A. Door holders shall be Glynn Johnson GJ 81H Series, or equal, unless otherwise specified. Holders for locations noted as (ss) shall be fabricated with stainless steel components. Numbers specified in paragraph 3.02 are Glynn Johnson.

## 2.06 SURFACE BOLTS

- A. Surface bolts shall be 8-inch Ives 1630 series, or equal. At doors with (ss) hardware, bolts shall be 8-inch Ives 1640 Series, or equal.

## 2.07 KICKPLATES

- A. Kickplates shall be Rockwood, or equal, 6 inches high. Kickplate width shall be 2 inches less than door width.

## 2.08 DOOR STOPS

- A. Provide wall- or floor-mounted door stops at all interior doors. Stops shall be Glynn Johnson GJFB-13, GJ60C, GJ60W for locations noted as (ss), or equal.

## 2.09 THRESHOLD AND WEATHERSTRIPPING

- A. All exterior doors shall be weatherstripped with Reese DS106, National Guard Products, Inc. 190, or equal, weatherstripping. Provide Reese 323C, Pemko 315AN, or equal, sweeps; and Reese S425A, Pemko 171A.

## 2.10 KEYING

- A. Door keys shall be keyed to match other City of Madison well facilities that have Sargent key systems. Provide two keys per lock. Doors shall have temporary construction cylinders. Provide permanent cylinders at project completion.

## 2.11 LATCH PROTECTION PLATE

- A. Latch protection plate to be 3 inch by 11 inch for use with cylindrical locksets with a 2 3/4-inch backset. Protection plate to be steel with finish to match door hardware, Hager 341D, DonJo MLP211, or equal.

## 2.12 ELECTRIC STRIKE

- A. Provide electric strike Model 6117 by VonDuprin or equal. Strike shall be stainless steel, nonhanded, fail secure, adjustable, and have plug connectors. Division 16 will provide corresponding controls and power transformer to be installed by CONTRACTOR. Coordinate with equipment provided.

## 2.13 FINISH

- A. Finish for all hardware, except as noted below, shall be US 26D or US 32D where stainless steel (ss) hardware is specified in paragraph 2.
- B. Finish for surface bolts shall be US 26D; finish for kickplates shall be 32D.
- C. Where stainless steel (ss) is specified, all hardware, including threshold and weather stripping, shall be installed with stainless steel fasteners.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Provide finish hardware to fully equip all doors.
- B. Install hardware in accordance with manufacturer's instructions.

### 3.02 SCHEDULE

- A. Provide the following hardware groups in the amounts indicated on the door schedule or required for a complete and proper installation:

#### Group 1

Lockset–10G05  
Door Closer–1460H (Parallel Arm)  
Butts & Kickplate

#### Group 2

Lockset–10G05 (ss)  
Door Closer–1460 (ss) (Parallel Arm)  
Butts & Kickplate (ss)

#### Group 3

Exit Device–9975L (ss)  
Door Closer–1460 (ss) (Parallel Arm)  
Butts & Kickplate (ss)  
Electronic Strike  
Latch Protection Plate

#### Group 4

Surface bolts–One top and bottom (ss)  
Door Holder GJ 81 H–HD (ss)  
Butts & Kickplate (ss)

Group 5

Latchset 10U15 (ss)  
Door Closer-1460 BF (Regular Arm) (ss)  
Butts & Kickplate (ss)  
Weatherstripping & Threshold

Group 6

Lockset 10U65  
Butts

END OF SECTION

## SECTION 08800

### GLAZING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes glass and glazing door lights.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. GANA–Glass Association of North America.

#### PART 2–PRODUCTS

##### 2.01 INTERIOR GLASS

- A. Glass in interior windows and interior door lights, except as noted, shall be 1/4-inch-thick float glass, fully tempered.
- B. Acceptable manufacturers include the following, or equal: Oldcastle Glass Company, PPG.

##### 2.02 GLAZING COMPOUNDS AND ACCESSORIES

- A. Glazing system shall consist of a polyisobutylene-butyl tape, liquid polymer sealant, and vinyl roll-in strip.
- B. Acceptable products include the following, or equal:
  - 1. Tremco Vision Strip System.
  - 2. General Electric Silglaze.

##### 2.03 FABRICATION

- A. Glazing of windows shall be from the interior.
- B. Accessories such as setting blocks, clips, etc., shall be provided to properly set glass.
- C. Obtain sizes from work at the site or from the manufacturer of work into which the materials will be set. Responsibility for the correctness of measurements shall be assumed by CONTRACTOR.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Comply with "Glazing Manual" by Glass Association of North America (GANA), except as specifically recommended otherwise by manufacturers of the glass and glazing materials.
- B. Completed installation shall be water- and airtight.

END OF SECTION

## SECTION 09250

### GYPSUM BOARD

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes gypsum wallboard, accessories, and texture finish.
- B. Related Sections: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM C36–Gypsum Wallboard.
- B. ASTM C475–Joint Treatment Materials for Gypsum Wallboard Construction.
- C. ASTM C630– Water-Resistant Gypsum Backing Board.
- D. ASTM C840–Application and Finishing of Gypsum Board.
- E. ASTM E119–Fire Tests of Building Construction and Materials.

##### 1.03 REGULATORY REQUIREMENTS

- A. Conform to the Wisconsin Commercial Building Code for fire-rated assemblies.

##### 1.04 ENVIRONMENTAL CONDITIONS

- A. Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer's recommendations.
- B. For nonadhesive attachment of gypsum board to framing, maintain not less than 40°F. For adhesive attachment and finishing of gypsum board, maintain temperature uniformly within the range of 55°F to 70°F for 48 hours prior to application and continuously thereafter until drying is complete.
- C. Ventilate building spaces to remove moisture not required for drying joint treatment materials. Avoid drafts during dry hot weather to prevent materials from drying too rapidly.

#### PART 2–PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal:
  - 1. United States Gypsum Company (USG).
  - 2. Gold Bond Building Products Division, National Gypsum Company.

## 2.02 MATERIALS

- A. Gypsum Wallboard-Interior Sheathing:
  - 1. Provide gypsum board conforming to ASTM C36, in maximum lengths available to minimize end to end joints.
  - 2. Provide moisture-resistant gypsum wallboard conforming to ASTM C630 USG Sheetrock W/R Gypsum Panels, 5/8-inch-thick.
- B. Gypsum Wallboard-Exterior Sheathing:
  - 1. Provide gypsum board conforming to ASTM C36, in maximum lengths available to minimize end to end joints.
  - 2. Gypsum board shall be 5/8-inch USG Sheetrock Brand Gypsum Sheathing, or equal.
- C. Accessories:
  - 1. Provide materials complying with ASTM C475, ASTM C840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.
  - 2. Reinforcement at exterior corners shall be USG Galvanized Dura-Bead No. 101, Gold Bond Standard Cover Bead, or equal.
  - 3. Reinforcement at internal corners shall be USG No. 100 Perf-a-Tape, Gold Bond Joint Tape, or equal.
  - 4. Provide trim accessories as required.
  - 5. Provide No. 200 case beads and other accessories as detailed or required.
  - 6. Joint compound shall be USG Durabond 90, Gold Bond Sta-Smooth, or equal, at cased edge joints.
  - 7. Furring channels shall be 7/8-inch metal, hat-shaped.
- D. Finish Materials: Interior textured finish shall be USG Spray Texture Finish; Gold Bond Spray Quick, medium-fine finish, or equal.

## PART 3-EXECUTION

### 3.01 EXAMINATION

- A. Examine substrate to receive gypsum wallboard systems for alignment, support, bracing, etc., prior to installation. Shim, block as required to comply with tolerances.
- B. Verify that the installation of all blocking, mechanical, and electrical work is completed.

### 3.02 INSTALLATION

- A. Install and finish gypsum board to comply with ASTM C840.
- B. Direct Attachment:
  - 1. All ends and edges of Sheetrock shall occur over nailing members except when joints are at right angles to framing members.
  - 2. All wallboards shall be applied horizontally. All ends and edges shall fit neatly. End joints shall be staggered. Joints on opposite sides of a partition shall be arranged to occur on different studs.
  - 3. Sheetrock shall be applied to studs by power-driven 1 1/4-inch Type W screws, spacing not to exceed 12 inches on center.

4. Fasteners shall be at least 3/8-inch from edges.
- C. Direct Furring Channel Attachment:
1. Apply gypsum panels horizontally (right angles to framing). Use maximum practical lengths to minimize end joints. Fit ends and edges closely but not forced together. Stagger end joints in successive courses. When necessary, cut ends, edges, and cutouts within the field of the panel in a workmanlike manner.
  2. Drive fasteners in field of panel first working towards ends and edges. Hold panel in firm contact with framing while driving fasteners. Space perimeter fasteners at least 3/8-inch from ends and edges.
  3. Attach gypsum panels to framing supports by power-driven USG brand screws, Gold Bond 1 1/4-inch Type A drywall screws, or equal, spaced 12 inches on center maximum.
- D. Cut openings required for ducts, piping, etc., above ceiling plane or fit panels after installation.
- E. Provide edge trim at all exposed edges of board and where board abuts dissimilar material. No raw drywall shall abut another material without a bead.
- F. Treat cut edges and holes in moisture-resistant gypsum board with sealant.
- G. Provide control joints at locations indicated or, if not indicated, at spacings and locations required by referenced gypsum board application and finish standard to prevent cracking of finished drywall.
- H. Patch all existing areas that are modified or damaged.

### 3.03 JOINT TREATMENT

- A. Finish all exposed-to-view surfaces.
- B. Reinforce and trim all joints, vertical and horizontal corners, and exposed edges.
- C. Fill with finishing compound all joints, fastener heads, trim accessory flanges, and other depressions in the surface of the wallboard to obtain a smooth flush surface.
- D. Prefill all V-grooved SW board. Butter all joints. Embed tape and apply skim coat of joint compound.
- E. Do not use topping compound for embedding tape.
- F. Do not intermix joint compounds.
- G. Spot fastener heads and fill beads and trim.
- H. Apply second and third coats.
- I. Allow drying time between application of joint compound in accordance with manufacturer's recommendations for the relative humidity and temperature levels at the time of application. In no case allow less than 24 hours drying time between applications of joint compound.

- J. Lightly sand joint compound smooth between coat applications.
- K. Apply not less than three separate coats of joint compound over joints, fastener heads, and metal flanges on surfaces exposed to view.
- L. Where not exposed to view within building, embed tape at joints and skim coat with joint compound.
- M. Finishing work will not be considered acceptable if corners of edges do not form true, level, straight, or plumb lines, or if joints, fasteners, head, flanges of trim accessories, or defects are visible after application of field-applied decoration.

#### 3.04 TEXTURE FINISH

- A. Apply a single coat of texture finish to all exposed surfaces scheduled to be painted only. See Finish Schedule on the drawings.
- B. Apply finish to an area of approximately 200 square feet and obtain OWNER's approval. Approved area shall establish standard for all the work.
- C. Protect adjacent surfaces from texture droppings or overspray.
- D. The spray shall be uniform and free from application patterns.
- E. The spray equipment shall be of such a size and type to provide acceptable results.
- F. Apply at a minimum rate of 200 square feet per gallon.

END OF SECTION

## SECTION 09670

### RESINOUS FLOORING

#### PART 1—GENERAL

##### 1.01 WORK

- A. Work included: Provide decorative quartz epoxy flooring.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Standard Division 1

##### 1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).

##### 1.04 SUBMITTALS

- A. Prior to commencing work, submit manufacturer's technical information and installation details to describe material to be used.
- B. Submit manufacturer certificate of compliance that materials meet specification requirements.
- C. Before beginning work, provide samples for the flooring system for approval.

##### 1.05 QUALITY ASSURANCE

- A. Contractor shall be an established firm regularly engaged in satisfactory installation of similar material for the past 5 years. Provide a letter of certification my manufacturer that Contractor is a current qualified installer.
- B. Single source responsibility: Provide fillers, primers, body coats, and topcoats produced by the same manufacturer and supply of principal material or work in this section.

##### 1.06 DELIVERY AND STORAGE

- A. Deliver material to project site in manufacturer's original unopened containers bearing manufacturer's name, product and color.
- B. Store material indoors, room temperature 77°F. Protect from damp, moisture and direct sunlight.

##### 1.07 PRODUCT CONDITIONS

- A. Evaluate the substrate condition, including moisture content and extend of substrate leveling and repairs required, if any.

- B. Coordinate flooring work with other trade to ensure adequate illumination, ventilation, and dust free environment during application and curing of flooring.
- C. Comply with material manufacturers recommended temperature limitations for flooring application.

## PART 2–PRODUCTS

### 2.01 APPROVED MANUFACTURERS

- A. MICOR Company Inc., Milwaukee, WI 53216 Phone (414-872-2071) Fax (414-873-3904), or equal.
- B. Primer: MICOROX® 103 epoxy primer.
- C. Decorative Resinous liquids shall be blended silica aggregated in an epoxy resin binder broadcast with colored quartz aggregate and top coated with 100% solids, cycloaliphatic amine cured sealer. Nominal application to be 1/4 inch thick.
- D. Ceramic-coated aggregate shall be used to achieve color. Color to be chosen by OWNER.
- E. Epoxy Sealer: Clear, two component 100% solids epoxy seal coat(s) MICOROX® 1882

## PART 3–EXECUTION

### 3.01 SURFACE CONDITIONS

- A. Surface shall be clean and dry, physically sound, and free of contamination, hole voids, or defects. Correct ricks and abrupt changes in surface profile. Remove fins, projections, curing compounds, and sealers.
- B. Verify the moisture content is within range acceptable to flooring manufacturer, using calcium chloride test kit or plastic sheet method per ASTM 4263.
- C. Report, in writing, surfaces left in improper condition by other trades. Application will constitute acceptance of surfaces.

### 3.02 PREPARATION

- A. No curing agents or sealers may be used that interfere with the adhesion of the coating applied. If such materials are applied, cement contractor shall bear all costs incurred for removal.
- B. New concrete shall have a minimum of 28 days cure prior to coating application.
- C. Clean floor surface to remove all dirt, dust, grease, oil, old coatings, and loose concrete by abrasive blasting in accordance with SSPC-SP13/NACE No. 6. Final surface must allow proper bonding of the primer coat to the substrate.

- D. Cracks and voids shall be repaired or filled only with materials approved by MICOR Company, Inc.
- E. CONTRACTOR and OWNER shall determine if present floor slopes adequately to insure proper drainage in the areas to receive decorative quartz flooring. Should existing floor require repitching, consult manufacturer's representative for recommendations.

### 3.03 INSTALLATION

- A. Install specified materials in strict conformance to manufacturer's written instructions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider stripes, control joints, or other types of joints (if any), indicated or required.

### 3.04 CLEANUP

- A. Remove waste materials, rubbish and debris and dispose of them at OWNER's direction. Leave work areas in a clean condition.
- B. CONTRACTOR, Project Manager, or OWNER will be responsible for protection of floors from damage by other trades and for final cleanup upon completion of project.

### 3.05 PROTECTION

- A. Protect completed work from water, airborne particles, or other surface contaminants until cured and tack free, approximately 12 hours after application.
- B. Protect completed system from immersion and chemical exposure until thoroughly cured, approximately 24 hours.

END OF SECTION

## SECTION 09900

### 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 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM B117–Test Method of Salt Spray (Fog) Testing.
- B. ASTM D2247–Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- C. ASTM D3363–Test Method for Film Hardness by Pencil Test.
- D. ASTM D4060–Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- E. ASTM D4541–Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. ASTM D4585–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 01300–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 Material Safety Data Sheets (MSDS) for each type of paint with each shop drawing submittal. MSDS 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:
  - 1. All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
  - 2. All paints shall be NSF Standard 61-approved when they are in contact with potable water or within potable water reservoirs.
- 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 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.

#### 1.06 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.

#### 1.07 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, 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. 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. Staurolite 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.

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. New and existing ductile iron pipe shall be prepared by abrasive blasting per National Association of Pipe Fabricators NAPF 500-03.
6. Existing motors and pumps which are to remain shall be power tool cleaned as specified in SSPC-SP15 Commercial Grade Power Tool Cleaning. Existing ferrous metal materials which are impractical to abrasive blast on site 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.
7. 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. All new concrete and precast concrete walls, floors, and ceilings shall be abrasive blast cleaned in accordance with SSPC-SP13/NACE No. 6 in order to prepare the surfaces for adherence of the painting systems as specified. Abrasive blasting of concrete shall result in a surface profile in accordance with ICRI No. 03732 at CSP-3 to CSP-5. Bug-holes that are opened up shall be filled with an appropriate filler.
3. Bug-holes shall be filled as specified in Section 03300–Cast-in-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
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.

D. Existing Concrete and Concrete Block:

1. All previously coated 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 concrete and precast concrete walls, floor, and ceiling 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. 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.
- E. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with non-hydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC SP 1 and shall be abrasive blasted in accordance with SSPC-SP7.
- F. Copper: Where copper piping is not submerged or buried, it shall be solvent cleaned in accordance with SSPC SP 1 and shall be lightly sanded.
- G. PVC and CPVC: All PVC and CPVC to be painted shall be solvent cleaned in accordance with SSPC SP 1 and shall be lightly sanded.
- H. Aluminum: Where listed in the Schedule to be painted, it shall be solvent cleaned in accordance with SSPC SP 1 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 07900 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 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 and Equipment Bases: See Section 09670–Resinous Flooring.
  - 3. Interior Concrete Block Walls: Three coats of N69 Hi-Build Epoxoline II, Macropoxy 646. If lightweight concrete block is used, four coats as specified, minimum, shall be applied.

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

4. All Exposed Concrete Ceilings (ceilings of water-containing tanks are not considered exposed):
  - a. One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, thinned 10%; and one coat of N69 Hi-Build Epoxoline, Macropoxy 646.
5. Cast or Ductile Iron; Not Submerged or Buried:
  - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
  - b. Touch up prime coat prior to finish coating; and apply either:
    - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
    - (2) One coat of N69 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:
  - a. Not painted.
7. Cast or Ductile Iron; Submerged:
  - a. One shop coat N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
  - b. Touch up prime coat prior to finish coating; and two coats of N69 Hi-Build Epoxoline II, Macropoxy 646.
  - c. For Areas in Contact with Potable Water:
    - (1) One shop coat of N140-1255 Beige Pota-Pox Plus, Macropoxy 646 NSF Beige as primer;
    - (2) Touch up prime coat prior to finish coating; and one coat of N140-11WH White Pota-Pox Plus, Macropoxy 646 NSF White; and one coat of N140 Pota-Pox Plus, Macropoxy 646 NSF.
8. Steel, Machinery, and Equipment; not Submerged:
  - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
  - b. Touch-up primer prior to finish coat; and either:
    - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
    - (2) One coat of N69 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 8 FOR FACTORY APPLIED DOOR PRIMERS.

9. Motors, gear drives, and doors delivered with non-epoxy 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 N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
    - (2) One coat of N69 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 N69-1255 High-Build Epoxoline, Macropoxy 646 Beige as primer; and two field coats N69 High Build Epoxoline II, Macropoxy 646.
  - b. For Areas in Contact with Potable Water:
    - (1) One shop coat of N140-1255 Beige Pota-Pox Plus, Macropoxy 646 NSF Beige as primer; and touch up prime coat prior to finish coating; and one coat of N140-11WH White Pota-Pox Plus, Macropoxy 646 NSF White; and one coat of N140 Pota-Pox Plus, Macropoxy 646 NSF.

11. Galvanized, Copper, Brass, CPVC, and PVC; not Submerged or Buried:
    - a. One coat of N69-1255 Hi-Build Epoxoline II, Macropoxy 646; and either:
    - b. Two coats of N69 Hi-Build Epoxoline, Macropoxy 646 for interior surfaces; or
    - c. One coat of N69 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 6 Tnemec-Cryl, DTM Acrylic B66100.
  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 5.
  15. Stainless Steel: Not painted.
  16. Brick: 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.
- D. Existing Areas: Existing equipment and structures shall be painted in accordance with the following schedule and as listed in the Finish Schedule and as shown on the drawings.
1. DI Piping:
    - a. Prepare as specified.
    - b. Prime and finish coat in accordance with Item 6 of new work with shop primer replaced by field primer.
  2. Precast and Cast-in-Place Concrete Walls and Ceilings—Interior which remain exposed and are currently painted.
    - a. Prepare as specified.
    - b. Two coats of HB Tnemec-Tufcoat 114, Tile-Clad.
  3. Interior Concrete Block Walls which are currently painted and remain exposed:
    - a. Prepare as specified.
    - b. Two coats of HB Tnemec-Tufcoat 114, Tile-Clad.
  4. Interior concrete block walls in Chemical Room.
    - a. Prepare as specified.
    - b. Two coats 1074 Endura-Sheild, Acrolon 218 HS.
  5. Motors:
    - a. Prepare as specified
    - b. Prime and finish coat per item 9.
  6. Fiberglass Doors:
    - a. Hand sand to roughen existing surface.
    - b. Prime with Kem Kromik Universal Metal Primer at 3.0 mils DFT.
    - c. Two finish coats of 1074 Endura-Shield, Acrolon 218HS at 2.5 mils DFT each coat.
  7. Exterior Concrete Fascia:
    - a. Abrasive blast as specified.
    - b. Two coats of Sher-Cryl HPA @3.0 mils DFT per coat.
- E. 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>		
6 Tnemec-Cryl, DTM Acrylic B66100	200	
N69 Hi-Build Epoxoline II, Macropoxy 646		
Concrete Block Primer Coat	90	---
Concrete Block Intermediate Coat(s)	130	---
Concrete Block Finish Coat	140	---
Concrete Primer Coat	100	---
Concrete Intermediate Coat(s)	140	---
Concrete Finish Coat	160	---
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
140 Pota-Pox Plus, 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
114 Tnemec-Tufcoat, Tile-Clad	130	
1074 Endura-Shield II, Acrolon 218HS	---	2.5

\*\* 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 assure coverage.

F. Colors:

1. Colors are to be selected by OWNER, with the following piping colors used where applicable:
  - Gas line - orange
  - Potable water line - blue
  - Chlorine or sodium hypochlorite line - yellow
  - Sulfur dioxide or bisulfite line - light green with 6-inch yellow band at 30-inch centers

Fluoride	- light blue with 6-inch red band at 30-inch centers
Compressed air line	- green
Fire protection lines (where exposed)	- red

2. Bands above may be similar to labels supplied as specified below. Colored tape will not be permitted.

- G. Labels: In addition to the color code, each pipe shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Labels shall be abbreviated as noted under fluid abbreviations on the drawings. Labels shall be painted with stencils, 2-inch letters on pipes 4 inches and larger and 1-inch letters on pipes smaller than 4 inches. Labels shall include arrows indicating direction of flow. Snap-on pipe markers with permanent tension built into each plastic marker to grip pipe firmly may be used instead of painted labels. Snap-on labels shall be Brady, System 3, or equal mechanically affixed pipe markers.
- H. 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. Color coding shall also be used.
- I. 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. Fiberglass doors.
  2. Factory finished HVAC equipment.
  3. Chemical Feed System Pumps and Accessories.
  4. Air Strippers.
  5. Motor Control Centers.
  6. Supervisory Control Centers.

END OF SECTION

## SECTION 10441

### PLASTIC AND METAL SIGNS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Facility sign, bronze plaque, room signs, site signs, and caution signs.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit under provisions of Section 01300–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 ROOM SIGNS

- A. Provide room signs, W.H. Brady Co., B-909, or equal. OWNER shall select color.
- B. Sign shall also incorporate handicap accessible symbol.

##### 2.02 CAUTION SIGNS

- A. CONTRACTOR shall provide CAUTION signs as detailed on drawings for reservoir.
- B. Signs shall be fiberglass with black letters on yellow background, Brady Systems, B-120, or equal.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install signs after surfaces are finished in locations as directed.

##### 3.02 SCHEDULES

- A. Provide one "UNISEX" both room sign.

B. Provide CAUTION signs at all reservoir entrances. Provide 2 total.

END OF SECTION

## SECTION 10520

### FIRST AID KIT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: First aid kit.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURER

- A. First aid kit shall be Johnson and Johnson Model No. 3114-2 wall-mounted (50-person 225-item kit), Lab Safety Supply Co. (800-356-0783), or equal.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION

- A. First aid kit shall be wall-mounted.
- B. Mount where requested by OWNER.

END OF SECTION

## SECTION 10522

### FIRE EXTINGUISHERS AND ACCESSORIES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Fire extinguishers.
  - 2. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/NFPA 10–Portable Fire Extinguishers.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.
- B. Product Data: Provide extinguisher operational features, color and finish, anchorage details, and cabinet dimensions.

##### 1.04 QUALITY ASSURANCE

- A. Provide units conforming to NFPA 10 requirements for portable fire extinguishers.
- B. Provide fire extinguisher, cabinets, and accessories by single manufacturer.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. Larsen's Manufacturing Company, Product MP Series.
- B. Substitutions: Under provisions of Section 01600–Materials and Equipment.

##### 2.02 EXTINGUISHERS

- A. Provide one dry chemical-type, Larsen's MP Series, 10-pound capacity fire extinguishers. Fire extinguishers shall be UL-approved for Class A, Class B and Class C fires.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place extinguishers in brackets where shown on the drawings.
- C. Mount fire extinguisher so the handle is at 48 inches above the finished floor.

END OF SECTION

## SECTION 10800

### TOILET AND BATH ACCESSORIES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Toilet and washroom accessories.
  - 2. Grab bars.
  - 3. Attachment hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI A117.1–Safety Standards for the Handicapped.
- B. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A167–Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A269–Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- E. ASTM A366–Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
- F. ASTM B456–Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

##### 1.03 REGULATORY REQUIREMENTS

- A. Conform to ANSI A117.1 and Federal ADA-AG code and the Wisconsin Commercial Building Code for access for the handicapped.

#### PART 2–PRODUCTS

##### 2.01 TOILET TISSUE DISPENSERS

- A. Multiroll dispensers shall be surface-mounted. Bobrick B-288, Bradley 5402, or equal.
- B. Unit shall be Type 304 stainless steel with satin finish.

##### 2.02 SOAP DISPENSER

- A. Surface-mounted liquid soap dispensers shall be Bobrick B-86, Bradley 5050, or equal.
- B. Unit shall be chrome-plated brass with plastic container. Unit shall be impact-resistant polymer with corrosion-resistant valve capable of dispensing EA-rated soaps.

- C. Install one above each toilet room sink.

#### 2.03 TOWEL DISPENSERS

- A. Surface-mounted, 400 single fold towel dispensers shall be Bobrick B-263, Bradley 251-15, or equal.
- B. Unit shall be Type 304 stainless steel with satin finish.
- C. Locate near toilet room sink.

#### 2.04 WASTE RECEPTACLE

- A. Waste receptacles shall be swing-type, free-standing Bobrick B-2250, Bradley 377, or equal.
- B. Units shall be stainless steel with satin finish.
- C. Provide one unit in toilet room.

#### 2.05 MIRRORS

- A. Mirrors shall be shelfless mirrors without frames, 24 inches by 36 inches high, Bradley 747 with clip fasteners, or equal.
- B. Mirrors shall have heavy gauge 304 stainless steel frame with satin finish and No. 1 quality, 1/4-inch float plate glass mirror.

#### 2.06 GRAB BARS

- A. Provide stainless steel, peen grip with satin finish, 1 1/4-inch-diameter grab bars. Bars shall be concealed mounted type, Bobrick B-550.99X18, B-550.99X36 and B-550.99X42; Bradley 832-00118, 832-00136 and 832-00142, or equal.
- B. See drawings for configuration of grab bars.

#### 2.07 UNDERSINK PROTECTIVE PIPE COVERS

- A. ADA-conforming, wheelchair-accessible lavatory P-trap and angle valve assemblies shall be covered with molded, antimicrobial undersink protective pipe covers, TRUE BRO, INC. LAV GUARD #103 and #403, 1-800-340-5969, or equal.
- B. Cover shall be secured with reusable fasteners and access covers.
- C. Coordinate protective pipe covers for tailpiece and extensions to fit lavatories.
- D. Standard color to be selected by OWNER.

#### 2.08 KEYING

- A. Supply two keys for each accessory to OWNER.

- B. Key all accessories alike.

### PART 3-EXECUTION

#### 3.01 INSTALLATIONS

- A. Install accessories in accordance with manufacturers' instructions, ANSI A117.1, Federal ADA-AG, and the Wisconsin Commercial Building Code.
- B. Install plumb and level, securely and rigidly anchored to substrate.

END OF SECTION

## SECTION 11216

### DEEP WELL TURBINE PUMP

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation one deep well turbine pump of the line shaft-type complete with pump bowl assembly, and electric motor. The existing column pipe, shaft assembly, and discharge head shall be reused. The pump and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Project Data/Bid Requirements:
  - 1. Bidder shall furnish with its Bid performance data and curves showing pump field delivery when driven by motor for alternative bid equipment only.
  - 2. Bidder shall furnish the following information in duplicate:
    - a. Name of pump manufacturer and type of model designation.
    - b. Field operating speed of unit. All performance data and tests shall be at this speed.
    - c. Number and size of bowls.
    - d. NPSH required for lowest stage.
    - e. Name of motor manufacturer and type or model designation of motor with full information on frame size, insulation, and temperature rating.
    - f. Motor rated horsepower without service factor.
    - g. Motor service factor.
    - h. Full load and locked rotor motor current.
    - i. Motor efficiency at half, three-quarters, and full load.
    - j. Maximum load on motor thrust bearing and 5-year life rated load.
    - k. Complete performance curves drawn for the equipment being offered (not a page from a catalog) showing field capacity-head from shutoff to cutoff, NPSH required, wire to water efficiency, and brake horsepower from shutoff to zero head.
    - l. Full descriptive literature on type of pump offered including a list of five similar installations where proposed unit has been in operation for a period of not less than 5 years.
  - 3. The above specifications and data, as approved by ENGINEER, shall become a part of the Contract, and the equipment shall be constructed and installed in accordance with them.
- B. Shop Drawings:
  - 1. Shop drawings showing complete base assembly and casing position shall be submitted to ENGINEER for review and approval.
  - 2. Submittals for motors shall include data sheets from motor manufacturer. Data sheets from the pumping equipment manufacturer or supplier are not acceptable.

- C. Factory Test Submittals:
1. All pumps shall be factory tested in accordance with AWWA E103 standard running test and discharge head hydrostatic test requirements plus the requirements of these specifications. Tests shall be made with the shop motor.
  2. Test points shall include shutoff head, rated head, plus at least three other points as required for accurate curve plotting. Test data shall be obtained and computations made so that field head-discharge curves, field wire to water efficiency curve, and field power consumption in kwh per 1,000 gallons at the performance point are submitted to ENGINEER.
  3. Pump heads shall not include velocity head or internal pump friction heads, and these heads shall not be included in performance curves. Test results shall be corrected to show field performance at the speed at which the unit will operate with 480 volts at the motor terminals.
  4. ENGINEER shall be furnished three certified copies of all test data, calculations showing losses not included in the shop tests, field performance curves, and computations and curves showing field power consumption by the motor and bhp load on the motor.
  5. Shipment shall not be made until ENGINEER approves the factory test data.

### 1.03 QUALITY ASSURANCE

- A. Regulatory Requirements: Electrical equipment shall conform to the standards of the AIEE, NEMA, and the NEC. Except as otherwise specified, the units shall conform to AWWA E103 and the requirements of the Wisconsin Department of Natural Resources.
- B. Certifications:
1. CONTRACTOR shall give ENGINEER, in writing, the exact distance from the top of the well curb to the bottom of the telltale lines. If lines are damaged in any way so that accurate readings cannot be obtained, they shall be replaced at the expense of CONTRACTOR.
  2. Provide certification of the absence of floating material in the well prior to starting work.
  3. Provide manufacturer's affidavit of compliance per AWWA E103.

### 1.04 PROJECT CONDITIONS

- A. Construction of the well below the curb is as follows:
1. Top of well curb—USGS Elevation—892.67 approximate..
  2. 30-inch outer casing 0 to 125 feet.
  3. 30-inch casing 0 to 172 feet.
  4. 22-inch open hole from 172 feet to 753 feet.
- B. Recent pump data collected by City staff reported a static water level of 69 feet below the well curb. The pumping water level was reported to be 141 feet while pumping at a rate of 2,160 gpm.
- C. The existing well pump is reported to be a Goulds model 14 RHJC, 2 stage, 1,770 rpm pump with a design capacity of 2,200 gpm at 140 feet. The pump is set to a reported depth of 190 feet. The column is reported to be a 12-inch flanged column with 1 1/2 inch water lubricated shafting.

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 earlier of either the date established for partial utilization in accordance with GC14.04 and 14.05, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Type of pump, efficiency, and head-discharge curve slope required to be similar to Goulds Model 14RJHC, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

2.02 EQUIPMENT

- A. Design Requirements:
  - 1. Pump heads as specified herein are field heads external to the pumping unit; they do not include velocity head or internal friction head, and these heads shall not be included in pump test head or pump performance data. Pump discharge head is that shown by a piezometer tap at the pump discharge.
  - 2. To convert pump bowl assembly heads or shop heads and shop test motor loads to field heads and field driver loads, hydraulic and mechanical friction loads as shown in AWWA E103 shall be used.
  - 3. A steep head discharge curve at performance point maintaining high efficiency each side of the performance point is desired, and this characteristic will be considered in awarding the Contract.
- B. Performance Requirements:
  - 1. Pump field head when pumping to the system at 2,200 gpm is calculated as follows:

Static lift in well	69.0 feet
Drawdown at specific capacity = 30 gpm/ft.	73.3 feet
Well and pump deterioration allowance	20.0 feet
Discharge static head	12.0 feet
System friction loss-piping	3.4 feet
System friction loss-sand separator	15 feet
Total field head at 2,200 gpm	192.7 feet

2. Under normal operating conditions, the pump shall have a minimum performance point capacity of 2,200 gpm against a total head exterior to the pump of 197.7 feet while at 1,780 rpm nominal speed.

## 2.03 COMPONENTS

- A. Bowls:
  1. The pump bowls are to be cast iron.
  2. Replaceable bowl wearing rings shall be provided.
  3. The bowls shall be no larger than nominal 14-inch-diameter.
- B. Impellers:
  1. The impellers are to be bronze.
  2. The impellers shall be fully enclosed.
  3. Impellers selection shall meet NPSH requirements with pumping level at the top of the bowl assembly, exclusive on the suction losses from the sand separator.
- C. The impeller shaft shall be Type 416 stainless steel with bronze bearings in each bowl.
- D. Suction and discharge nozzles shall be used below and above the bowl assembly with straightening vanes and long bearings for the pump shaft.
- E. Column:
  1. The existing column pipe shall be reused.
  2. Provide new flange bolts. Flange bolts shall be Type 304 or 316 stainless steel.
- F. Line Shaft: Reuse the existing line shaft. Provide new line shaft where it projects through stuffing box discharge head if required.
- G. Line Shaft Bearings: Reuse the existing bearings.
- H. Discharge Head: Reuse the existing discharge head.
- I. Miscellaneous Tubing:
  1. All miscellaneous tubing required in or on the pump for bearing cooling, drainage, lubrication, etc., shall be furnished and placed by the Pump Contractor. Tubing shall be brass or hard copper with sweated fittings. Unions shall be provided for dismantling.
  2. Insofar as practicable, all such piping and tubing is to be installed inside the pump head frame and must be installed in a workmanlike manner.
  3. The base of the discharge head shall have tapped openings and packing arrangement to obtain an air and watertight seal around two telltale airlines and carrier pipe placed by this CONTRACTOR; the openings so located that the airlines and level transducer cable have free and unobstructed passage into the well casing.
- J. Motors:
  1. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL listed for the service specified.
  2. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.

- a. Physical Construction:
    - (1) Copper leads and windings with ball or roller bearings in end brackets of steel or cast iron or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two windings for all two-speed motors. Motor leads shall have the same insulation class as the windings.
    - (2) Rotor bars shall be copper. Where installed in NEMA 4X and Class I, Division 1 locations, a 45% non-phosphorous silver copper brazing shall be applied.
    - (3) Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft run-out shall be 0.002-inch.
    - (4) Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
    - (5) The motor thrust bearing shall be rated for use with the motor and pump supplied. Minimum rated bearing life shall be 5 years. Nameplate data shall identify the bearing and the type and weight of lubricant required. Bearing shall be proper for use with motor and pump setting as described under line shaft.
  - b. Mounting: Vertical.
  - c. Enclosure: ODP.
  - d. Efficiency: Premium efficiency as noted in schedule below.
  - e. Service Factor: 1.10
  - f. Power requirements: 60 Hz, Three phase, 460 volt, factory-wired for 460 volt connection,  $\pm 10\%$  voltage variation.
  - g. Load type: Variable torque.
  - h. NEMA Design: B.
  - i. Insulation: Class F and rated for a Class B temperature rise.
  - j. Nominal operating speed: Single speed, 1800 rpm.
  - k. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
  - l. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and bar, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
  - m. Accessories:
    - (1) Non-reverse ratchet.
    - (2) Over-sized motor junction box.
    - (3) Lifting eyes.
    - (4) Thermostats applied to motor windings, capable of shutdown and manual reset by external controls (by Division 16).
  - n. VFD requirements: Motor operating on VFDs shall be inverter duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown of 10:1.
3. 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	Horsepower	Nominal Speed	Efficiency
WP-15-1	150	1,800	93%

K. Variable Speed Control Coordination:

1. The equipment manufacturer shall coordinate with the variable speed drive supplier (Division 16) at the time of equipment start-up to address minimum speed requirements to protect both motor and equipment and to meet specified design and performance requirements. Minimum speed settings (in hertz) shall be provided to OWNER. Equipment operation over the entire control range shall be completed to demonstrate successful operation and to meet specified design and performance requirements.
2. Pump manufacturer shall perform a vibration analysis and harmonics frequency test of the installed units to determine the actual field-defined range of VFD speeds that should be locked-out and where the VFD should be ramped across (not operate) in this range to limit harmonic frequencies. A vibration analysis and harmonics frequency test of the installed units shall be performed under the full range of operating conditions.

L. Drawdown Measurement:

1. Two air lines shall be furnished and installed.
2. They shall be 1/4-inch by 1-inch braid Dayco Thoro-Flo neoprene air hose as supplied by Industrial Rubber, Inc., Milwaukee. The hose shall be 1/2-inch O.D. and 250 psi working pressure.
3. Each air line shall be one length with no joints. The lower ends shall be placed at the top of the bowl assembly.
4. The hose shall be fastened to each length of column pipe with 2-inch-wide 3M No. 50 Scotch wrap and shall pass through the base of the discharge head in sanitary stuffing boxes.
5. The upper end of each hose shall be fitted with a brass or copper fitting for connection to 1/4-inch copper airline.
6. Two drawdown gauges calibrated in feet shall be provided.
7. Drawdown gauge shall be direct reading-type.
8. Toro 1/4-inch polyethylene tubing, Model 900-14, with greater than 1,000 psi burst strength may be used for air line in place of the material specified above.
9. One carrier pipe shall be furnished and installed for routing submersible level transducer by others. Carrier pipe shall be 1 1/2-inch-diameter PVC pipe.
10. Carrier pipe shall be Schedule 80 PVC and fastened to each length of column pipe using same method as noted above for airline. See Section 15040-Piping and Accessories for PVC pipe requirements. Piping shall be connected using push-on fittings without solvent welding for easy removal.
11. Fabricate and install stainless steel guards at each flange connection to protect PVC pipe from being damaged during pump installation.

M. Sand Separator

1. Sand separator shall be LAKOS Pump Protection Separator, Model PPS-1640-K, or equal.
2. Provide additional tail pipe sections from pump suction to separator to locate separator intake a minimum of 30 feet below the top of bowls.
3. Provide necessary reducers and fittings to connect to pump tail pipe.
4. Separator shall use centrifugal separating action to remove sand particles from water prior to sand entering the impellers.

5. Separator shall be provided with a rubber flapper valve to automatically release separated sand. Sand shall release on pump shutdown or when sand accumulation is great enough to open.
6. Separator shall be carbon steel with a minimum thickness of 0.25 inches. Separator shall be provided with factory standard finish.
7. The separator's flow range 1,640 gpm to 2,560 gpm. A flow adjustment collar shall be provided to fine tune separator to the design flow rate of the well.

## 2.04 FINISHES

- A. It is the intent of these specifications that equipment, support, and accessories be furnished factory shop-primed and factory-finished painted. Equipment and appurtenances shall be prepared in accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by manufacturer. Touch-up paint shall be provided by manufacturer.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Before installing the pump, CONTRACTOR shall remove any floating material from the well. CONTRACTOR shall also remove any material which falls into the well during removal and installation of the equipment.
- B. As the pump is being installed, it shall be washed inside and out with water containing 200 ppm of available chlorine per AWWA C654. All surfaces shall be wetted with the chlorine solution. CONTRACTOR shall sample for bacteria twice at least 8 hours apart. Results shall be reported to OWNER. If either sample is determined to be unsafe, CONTRACTOR shall rechlorinate per AWWA C654 and resample until two consecutive safe samples are obtained.
- C. The terminal box shall be located as requested by ENGINEER. Conduit interfering with removal and installation of well pump shall be provided with unions to permit removal during well pump maintenance operations.

### 3.02 FIELD QUALITY CONTROL

- A. Site Tests: Vibration:
  1. Vibration at any point on the equipment and shafting as operated in the field in excess of 4.0 mils shall be the cause for rejection. All surfaces intended for bearing shall be in full contact, and insertion of washers or spacers to minimize vibration will not be permitted.
  2. OWNER will make field and power tests to check compliance with the specifications.
- B. Penalties: If the unit after installation does not operate smoothly, does not meet the vibration limitations, or does not operate in accordance with the factory characteristics curve, it shall be adjusted until it meets these standards, or it shall be removed by CONTRACTOR. OWNER retains the right to assess a 5-year power consumption penalty if the pump does not operate according to the factory test power consumption curve once the pump is installed in the field.

END OF SECTION

## SECTION 11236

### LOW PROFILE AIR STRIPPERS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation a low profile, multi-tray air stripping system for removal of volatile organic compounds from water. The air stripping equipment and appurtenances shall be furnished by the same supplier. The system shall consist of:
  - 1. Two low profile air strippers.
  - 2. Two blowers with intake filters and silencers.
  - 3. Spare trays.
  - 4. Storage racks for spare tray storage and transport.
  - 5. Soaking sink for cleaning of trays.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 SYSTEM DESCRIPTION

- A. Process Description:
  - 1. The air stripper process shall allow influent water to be piped to the air stripper inlet distribution port. The water is then allowed to flow over a weir and through a series of sieve/aeration trays as it descends to a sump at the bottom of the unit. Air forced up through the sieve holes in each tray forms a froth of bubbles, generating gas/liquid contact surface area. This allows mass transfer of contaminants from the water into the rising air, which is exhausted at the top of the unit. A demister prevents release of water droplets in the exhaust.
- B. Design Requirements:
  - 1. The air stripping system shall be suitable for contact with potable water, trace levels of VOC contamination, and up to 2.0 ppm of chlorine in the water supply.
  - 2. Air stripping system components shall be suitable for contact with highly concentrated chlorine solution (200 ppm) used for disinfecting the strippers.
  - 3. Removable split trays shall be provided.
  - 4. System shall be of the forced draft design.
  - 5. System shall possess NSF 61 certification.
- C. Performance Requirements:
  - 1. Total system shall be capable of treating raw water flow rate of 2,200 gpm.
  - 2. Treatment system shall be sized to reduce incoming combined TCE and PCE levels of 20 ppb to less than 1.0 ppb.

##### 1.03 DEFINITIONS

- A. The following definitions or abbreviations apply to the work and products of this section:
  - 1. PPB-parts per billion.
  - 2. TCE-Trichloroethylene.

3. PCE-Tetrachloroethylene.

1.04 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- B. Project Date/Bid Requirements: Any alternative bid equipment Bidder shall furnish with its Bid:
  - 1. Shell and Tray material type and dimensions, including standard drawings.
  - 2. Air blower performance and motor horsepower.
  - 3. Operating conditions including design air to water ratio and total  $\epsilon$ P (inches w.p.) through stripper from air intake through demister for minimum 99% removals.
  - 4. A list of exceptions to the specifications including reasons for the exceptions and detailed information on the structural, mechanical, or other miscellaneous changes necessary to adapt equipment to the arrangement shown.

1.05 QUALITY ASSURANCE

- A. A list of at least 10 installations similar in size and capacity and approved for use in drinking water completed over the last 10 years shall be submitted with the bid for any alternative equipment bid. The list shall also include location, customer with contact person and phone number, unit size, capacity in gpm, and year installed.

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 in accordance with the City of Madison Standard Specifications.

PART 2--PRODUCTS

2.01 MANUFACTURERS

- A. The low profile air strippers shall be QED Environmental Systems Inc., E-Z Tray™ Removable-Tray Air Stripper, Model 96.6, of Dexter Michigan or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

## 2.02 GENERAL

- A. Products Description: All materials and products used with the low profile air strippers shall be compatible with trace levels (< 200 ppb) total concentration of VOC contaminants and up to 2.0 ppm of chlorine in the water supply.
- B. Materials: Air stripper shell and trays shall be constructed of type 304 stainless steel.
- C. Components:
  - 1. Shell:
    - a. The shell shall accommodate slide-out removable, interchangeable sieve trays for easy cleaning.
    - b. Access to the individual trays shall be provided via hinged doors, without requiring removal of influent, effluent, or air discharge piping. The hinged door shall be constructed of transparent materials to allow visual observation of stripper operation.
    - c. The shell shall be of one piece welded construction; to minimize seal and gasket requirements, sides shall be imperforate except for welded or flanged fittings used for air, liquid, or sensor connections and for hinged access doors.
    - d. Shell construction shall be of uncoated stainless steel. Construction must be suitable for all loads placed on shell, including but not limited to: loads resulting from internally supported parts, weight of operating liquid, piping, structural supports, internal or external pressure.
    - e. Shell design shall include mounting brackets suitable for hold-down on a skid or floor, plus forklift cutouts and/or lifting lugs to allow the unit to be moved easily without damage.
    - f. The air stripper shall be equipped with integral sump, tray support tracks, and a high efficiency demister, plus an external sump gauge to allow visual observation of water level, plus a high efficiency demister. Demister shall effectively remove water droplets at air flow velocity greater than stripper blower maximum capacity.
    - g. Shell shall permit additional tiers of trays to permit up to 6 tiers of trays.
    - h. Access taps and ports shall be provided to accommodate the specified monitoring equipment.
  - 2. Trays:
    - a. A minimum of four tiers of trays shall be provided with each stripping unit.
    - b. Trays shall be constructed of stainless steel with a slide-out design.
    - c. Trays shall have latches designed to hold them in position on the shell slide tracks.
    - d. Trays shall include a mechanical flow control device which will regulate water volume in each tray, preventing air short circuiting.
    - e. Trays shall be split trays to permit easier removal of trays for cleaning. Split trays shall weigh less than 40 pounds and allow for handling by one person.
  - 3. Blower:
    - a. The blower impeller, driven by direct-couple motor, pressurizes air and supplies it to the air stripper with sufficient flow and pressure to generate a froth of bubbles in the water contained by up to 4 tray tiers in the air stripper.
    - b. The blower shall be a direct drive pressure blower.
    - c. See Section 2 for motor requirements.
    - d. The blower shall be factory balanced and motor coupled
    - e. The blower shall possess an all-welded steel housing and aluminum wheel and built in water drain.
    - f. Provide flanged connections.

- g. The blower shall be employed for forced draft operation and deliver 5200 scfm air flow to the air stripper.
  - h. Blower shall be as manufactured by New York Blower Company, Willowbrook, Illinois.
4. Water inlet connection for each unit shall be 8-inch flanged connection.
  5. Outlet water connection for each unit shall be 10-inch flanged connection.
  6. Air inlet connection for each unit shall be 12-inch flanged connection.
  7. Air outlet connection for each unit shall be 16-inch flanged connection.
- D. Accessories:
1. Provide differential pressure gauges on each air stripper to monitor sump pressure. Differential gage shall be diaphragm actuated, dial type, with a 0 to 50-inch water range. Pressure gages shall be Dwyer Series 2000, Model 2050.
  2. Provide sump site glass with each air stripper connected to sump water drain for sump water level monitoring.
  3. Provide sump dual indication high level float switch with each air stripper. Float shall be used to generate high level warning and high- high level warning for system shut off. High level float switch shall be wired back to the supervisory panel. Coordinate with Division 16. Float shall be Warrick Model M-GRE-20.
  4. Provide low pressure switch with each air stripper. Low pressure switch shall be wired back to the supervisory panel. Coordinate with Division 16. Low pressure switch shall be Dwyer Series 1950, Differential Pressure Switch, Model 1950P-2.
  5. Provide sump high pressure switch with each air stripper. High pressure switch shall be wired back to the supervisory panel. Coordinate with Division 16. Sump high pressure switch shall be Dwyer Series 1950, Differential Pressure Switch, Model 1950P-2.
  6. Provide combination pressure gage/pressure switch to monitor air pressure on the blower suction for each blower. Pressure gage/pressure switch shall be Dwyer, Series 3000, Photohelic pressure gage with low/high set points. Wire low pressure set points back to supervisory panel.
  7. Provide a differential pressure transducer to monitor sump pressure. Sump differential pressure transducer shall be wired back to the supervisory panel.
    - a. Pressure transducers shall sense gauge or differential pressure and provide a 4.20 maDC signal proportional to the sensed pressure. The control system will provide 24VDC loop power. Increasing pressure shall result in increasing signal.
    - b. Transducers shall be suitable for use in ambient conditions of 0° to 180°F and 0% to 100% relative humidity.
    - c. Accuracy (including linearity, hysteresis, and repeatability) shall be a minimum of  $\pm 0.10\%$  of span. Long-term drift shall be less than  $\pm 0.1\%$  of the upper range limit over a 12-month period. The transducer output signal shall not change more than 0.0005% of span for a 1V change in the loop voltage. Ambient temperature affect shall be less than  $\pm 0.6$  psi for a 10 to 300 psi transducer that experiences a 100°F change in ambient temperature within the normal operating range. Mounting position shall not affect transmitter performance. RFI effect shall be less than 0.1% of span for radio frequencies in the range of 27 to 1,000 MHz and field intensity of 30V/m.
    - d. Process connection shall be 316L stainless steel fitting size and type as required by CONTRACTOR. Sensor material shall be 316L stainless steel, with silicone fill fluid. Sensor shall be suitable for use with process liquid/gas temperature from -50° to 250°F.

- e. Calibrated range shall be determined by the CONTRACTOR based on process conditions. Calibrated range and process conditions used to determine range and span limits shall be included in submittal.
  - f. Pressure transducer housing shall be NEMA 4X, epoxy-coated aluminum with a minimum of one 1/2-inch NPT conduit connection. Housing shall provide separation between electronics and field connections.
  - g. Digital indicator with transducer configuration pushbuttons shall be provided in the transducer housing. Transducer configuration shall be performed using pushbuttons on the transducer. A Hart communicator or other electronic device **shall not** be required to configure the transducer.
  - h. Transducer shall be direct-connected to process unless specified otherwise on the drawings. Provide stainless steel bracket and mounting bolts for surface mounting of transducer if wall mounting is specified. Provide stainless steel two-valve manifold for pressure transducers and stainless steel three-valve manifold with test ports for differential pressure transducers.
  - i. Provide stainless steel information tag that indicates instrument number, service, and calibration range.
  - j. Pressure transducers shall be Foxboro Model IGP20, ABB, or equal.
8. Provide demister on each air stripper discharge.
  9. Provide necessary tools to assist in the removal of trays from the air stripper shell.
  10. Provide one 304 stainless steel utility work soak tank for soaking and rinsing of air stripper trays during routine maintenance. The soak tank shall have nominal dimensions of 2'-6" by 6'-8" by 2'-0", exclusive of support legs. Provide two 1.5 inch taps with quarter turn isolation valves to drain tank.
  11. Air stripper manufacturer shall provide racks for storage and handling of spare trays during cleaning operations. The racks shall be capable of passing through a ## inch wide by 3-8 by 7-8 tall door and carry up to 12 trays and be provided with heavy duty casters. The rack dimensions shall have nominal dimensions of 3'-4" by 6'-0" by 7'-2". Racks shall be constructed of stainless steel. Provide one spare rack such that there is one empty rack available when all of the spare trays are in storage of the racks.
  12. Air stripper manufacturer shall provide gravity discharge drain boxes external to working sump which regulates water flow exiting the air stripper system and enhances removal of air entrained in the effluent stream. Gravity discharge boxes shall be constructed from 304L stainless steel. Provide 3/4 inch tap and smooth nose sampling tap on each gravity discharge box.

## 2.03 MOTORS

- A. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL listed for the service specified.
- B. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
  1. Physical Construction:
    - a. Copper leads and windings with ball or roller bearings in end brackets of steel or cast iron or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two windings for all two-speed motors. Motor leads shall have the same insulation class as the windings.
    - b. Rotor bars shall be copper.

- c. Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft run-out shall be 0.002-inch.
  - d. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
2. Mounting: Horizontal.
  3. Enclosure: TEFC.
  4. Efficiency: Premium efficiency as noted in schedule below.
  5. Service Factor: 1.10.
  6. Power requirements: 60 Hz, Three phase, 230/460 volt, factory-wired for 460 volt connection, ±10% voltage variation.
  7. Load type: Variable torque.
  8. NEMA Design: B.
  9. Insulation: Class F and rated for a Class B temperature rise.
  10. Nominal operating speed: Single speed, 3,600 rpm.
  11. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
  12. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and bar, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
  13. Accessories:
    - a. Nonreverse ratchet.
    - b. Oversized motor junction box.
    - c. Lifting eyes.
    - d. Thermostats applied to motor windings, capable of shutdown and manual reset by external controls (by Division 16).
  14. VFD requirements: Motor operating on VFDs shall be inverter duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown of 4:1.
- C. 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.

Blower	Horsepower	Nominal Speed	Efficiency
B-15-01	60	3600	93.6%
B-15-02	60	3600	93.6%

## 2.04 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16.
- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 16 contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are specified under Section 16480–Motor Control and Section 16940–Controls and Instrumentation of these specifications.

## 2.05 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

## 2.06 FINISHES

- A. It is the intent of these specifications that all equipment, support, and accessories, except for stainless steel, be furnished factory shop-primed and factory-finished painted. Equipment and appurtenances shall be prepared in accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by manufacturer. Touch-up paint shall be provided by manufacturer. Stainless steel shall be unpainted.

## 2.07 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 5.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Refer to requirements specified in Division 1 for equipment installation, quality control, testing, supervision, start-up, and operator training.

### 3.02 VARIABLE SPEED CONTROL COORDINATION

- A. The equipment manufacturer shall coordinate with the variable speed drive supplier at the time of equipment start-up to address minimum speed requirements to protect both motor and equipment and to meet specified design and performance requirements. Minimum speed settings (in hertz) shall be provided to OWNER. Equipment operation over the entire control range shall be completed to demonstrate successful operation and to meet specified design and performance requirements.

### 3.03 SYSTEM START UP AND OWNER'S INSTRUCTION

- A. The equipment manufacturer shall provide the required consecutive 8-hour days of supervisory personnel for start up of the equipment. The personnel shall make the necessary tests and adjustments to place the equipment into proper operation.
- B. The instructions shall include demonstration, assistance, review of the "Operation and Maintenance Manual," and instructions in the use of auxiliary equipment, etc.
- C. The supervisory personnel shall be a trained employee or representative of the air stripper manufacturer experienced in the installation of this type of equipment.

END OF SECTION

## SECTION 11261

### CHLORINATION EQUIPMENT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes relocating, modifying the existing, and placing into successful operation one chlorination system. The equipment and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Shop drawings showing system installation shall be submitted.
- B. Schematic diagram for installation must be reviewed by ENGINEER before approval of equipment will be made.

##### 1.03 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 earlier of either the date established for partial utilization in accordance with GC14.04 and 14.05, as modified in the Supplementary Conditions, or Substantial Completion of the project.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. The existing chlorination system is Chemical Injection Technologies Superior Model CL-16.

##### 2.02 EQUIPMENT

- A. The existing system consists of the following equipment:
  - 1. Two cylinder mounted VR-16 vacuum regulators.
  - 2. One SPR pressure relief/vent valve.
  - 3. One RM-1 remote meter lock set valve.
  - 4. Ejector/check valve assembly.
  - 5. 120 volt solenoid and receptacle.
  - 6. Strainer.
  - 7. Scaleton dual 150 pound cylinder scale.
  - 8. Scott Health and Safety Series 7200 chlorine leak detector with remote sensing head.

## 2.03 ACCESSORIES

- A. Provide new 2-inch PVC carrier piping, polyethylene tubing sized to injector, couplings, valves, and fittings to connect chlorine feeder to the point of chlorination. Provide necessary vent tubing with stainless steel screened outlet to outside from chlorinator. Provide one "Y" strainer for the water supply line.
- B. Provide solution-type diffuser with corporation cock and standard threads for 1 1/4-inch pipe tap required. Tap shall be bushed down if larger than needed. Injector nozzle shall be close coupled with corporation cock to allow for nozzle removal under system pressure.
- C. Provide water pressure gauge of proper range with shutoff valve for chlorinator.
- D. Provide chlorine leak detection kit that includes a bottle of ammonium hydroxide, 56% solution.
- E. Provide one 4-cylinder storage rack with safety chains.
- F. Emergency Shutoff System:
  - 1. Provide one emergency shutoff system for chlorination system. The emergency shutoff system shall be Series CR-12 Duplex Model II Emergency Shutoff System as manufactured by Halogen Valve Systems, Inc., or equal for chlorine cylinder valves.
  - 2. The emergency shutoff system shall be comprised of two electrically driven actuators that act directly upon the cylinder valve stem with a control panel. Motors shall be 12 Vdc powered by an uninterruptible 12V battery power supply in the control panel.
  - 3. Actuators shall mount upon the cylinder valve and yoke assemblies by means of a clamping mechanism and valve stem coupling to allow removal during cylinder changes. Provide adapter, if necessary, for utilizing the actuator with the chlorine regulator. The actuator shall be powered only in the closing direction. The actuator shall allow the plant operator to open or close the valve on the 150-pound cylinder using a twisted wrench when the actuator is installed.
  - 4. Provide storage bracket for temporary placement of actuator during cylinder changeout. One twisted chlorine wrench shall be provided. CONTRACTOR shall mount storage brackets in a convenient location adjacent to the chlorine cylinders.
  - 5. Duplex control panel shall be contained within a single electrical enclosure of NEMA 4X rating. Control panel shall contain a microprocessor programmed to control the valve closing cycle and torque applied, monitor and display status of battery, charging system and system readiness, as well as provide diagnostic system checks during the test cycles. Control panel shall detect a declining battery charge and close actuators on sustained power loss.
  - 6. The control panel shall house the battery and charging system. Status lights on the face of the controller shall indicate status of charger, battery, armed condition, and fault condition. Actuator test buttons for each actuator shall be mounted externally on the control panel.
  - 7. The control panel shall be designed to receive an external dry contact input signal from the emergency push button and chlorine leak detector in chlorine room or the test button on the control panel. The control panel shall provide output signals which initiate the actuators. The control panel shall be 120VAC.
  - 8. The control panel and emergency push buttons shall be provided as part of this system and mounted in the location as shown on the drawings.
  - 9. Provide cable from control panel to actuators. Coordinate cable length with CONTRACTOR.

- G. Provide one high/low vacuum alarm switch for the chlorination system. Alarm switch shall be Superior Model VAS-3, Digital Chlorine Vacuum Alarm Switch by Chemical Injection Technologies.

#### 2.04 FINISHES

- A. Provide factory-applied paint finish to all fabricated items; color to be manufacturer's standard.
- B. Piping, insulation, valves, fittings, and other items which are not provided with a factory finish shall be coated in accordance with Division 9.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Provide all necessary tubing, hose, couplings, fittings, and valves for a complete installation. Point of application for chlorine shall be as shown on the drawings.
- B. Mount leak detector no higher than 2 feet 0 inches above floor level.

#### 3.02 TESTING AND STARTUP

- A. Provide manufacturer's services for the following:
  - 1. Startup for each item of new and existing equipment.
  - 2. Field testing for each item of equipment.

END OF SECTION

## SECTION 11270

### FLUORIDATION EQUIPMENT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes modifying the existing fluoridation system and placing into successful operation one complete fluoridation system. The equipment and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 1 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 earlier of either the date established for partial utilization in accordance with GC14.04 and 14.05, as modified in the Supplementary Conditions, or Substantial Completion of the project.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. The existing feed unit is Pulsation Model LME 4TA-PHTI-500 with four function anti-syphon valve.

##### 2.02 ACCESSORIES

- A. Reuse existing force flow scale and Force Flow Model Solo indicator.
- B. Reuse existing solution tank.
- C. Reconnect existing vent pipe to solution tank.
- D. Provide with the fluoride system the following items: rubber gloves, dust mask, acid-resistant apron, and protective goggles.
- E. Include 3/4-inch corporation cock with NPT thread, check valve, and solution tube for point of application. Provide all new tubing for metering pump suction. Pressure relief and solution feed.

##### 2.03 FINISHES

- A. Factory fabricated items shall have a factory-applied finished paint system.
- B. Other items shall be painted per Division 9.

- C. Plastic solution tank shall not be painted.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Provide all necessary tubing, hose, pipe, couplings, fittings, and valves for a complete installation. New point of application for fluoride shall be as shown on the drawings.
- B. Fluoride feed pump shall be mounted on existing stainless steel stand adjacent to solution tank.
- C. Provide new screen on end of existing solution tank vent pipe.

END OF SECTION

## SECTION 12692

### FLOOR MATS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: MCC mats.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 DIAMOND PLATE MCC MATS

- A. MCC 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 all motor control centers and any other freestanding or pad-mounted electrical equipment.

END OF SECTION

## SECTION 15000

### GENERAL REQUIREMENTS FOR MECHANICAL WORK

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All material, piping and installation for piping and appurtenances, mechanical insulation, plumbing, heating, ventilating, and air conditioning.
  - 2. Concrete foundations and anchor bolts for all equipment furnished under this division.
  - 3. Connections to all equipment whether furnished under this division or not.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Work of Other Divisions: CONTRACTOR for this work shall coordinate its work with that of any other contractors working in the same construction area. The contractors shall make a mutual agreement as to when piping and appurtenances shall be installed so as to minimize interference with each other's work.
- D. Finishes: Unless otherwise specified, valves, piping, and mechanical equipment items shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC, and underground piping) 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 equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to 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 9.
- E. Electrical Controls: All electrical controls shall be furnished and installed under Division 16, except for those items specified to be furnished with the equipment. Where electrical controls are specified to be furnished with the equipment, electrical controls shall be in accordance with Division 16 unless otherwise specified.
- F. Equipment Foundations: CONTRACTOR shall construct concrete foundations for all equipment and control panels under this Contract unless noted otherwise. Foundations shall generally be at least 4 inches high, shall consist of six-bag mix concrete, anchor bolts, reinforcing rod dowels into building concrete, and grouting with nonshrink element (containing no iron filings) where required. More specifically, concrete and grout shall meet the requirements found in Division 3.
- G. Concrete: All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 3.

## 1.02 CONTRACT DOCUMENTS

- A. 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.

## 1.03 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 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.

## 1.04 SUBMITTALS

- A. See Section 01300–Submittals for shop drawing submittal procedures.
- B. Applicable provisions of Section 01700–Contract Closeout govern requirements for record drawings, operation and maintenance data, and warranty information.
- C. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

## 1.05 DELIVERY STORAGE AND HANDLING

- A. Applicable provisions of Section 01600–Materials and Equipment govern the handling, storage, and protection of materials and equipment.

## 1.06 MAINTENANCE MANUAL

- A. Applicable provisions of Section 01300–Submittals cover requirements for operation and maintenance manuals.

## 1.07 SEQUENCING

- A. Applicable provisions of Section 01010–Summary of Work govern construction sequencing.

## 1.08 WARRANTY

- A. Applicable provisions of Section 01700–Contract Closeout govern product warranties.

1.09 SYSTEM START-UP

- A. Applicable provisions of Section 01650–Starting of Systems govern start-up and testing.
- B. 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.
- C. All costs of supervision, operator training, and start-up shall be included in the Bid.

1.10 MAINTENANCE

- A. CONTRACTOR shall furnish a one-year supply of grease and oils for all items of equipment requiring lubrication. Lubricants for all items of equipment shall be the same brand, when available, as recommended by the manufacturer to meet both warm and cold weather requirements.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 15040

### PIPING AND ACCESSORIES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Aboveground and exposed piping and valves of every description.
  - 2. Wall pipes and fittings.
  - 3. Concrete foundations and anchor bolts for all equipment furnished under this section.
  - 4. Piping connections to all aboveground or exposed equipment whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Shop Drawings: General arrangement drawings of all interior cast or ductile iron or steel piping with all equipment attached shall be submitted to ENGINEER for approval prior to installation. Additional shop drawing requirements are found in the General Conditions and Division 1. Drawings shall include proposed length, location and elevation of pipe, fittings, valves, and other appurtenances.

#### PART 2–PRODUCTS

##### 2.01 MATERIALS–GENERAL

- 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 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. All materials shall be National Sanitation Foundation (NSF)-approved.
- B. Size, Type, and Joining:
  - 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 fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted to ENGINEER for review.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER.

## 2.02 PIPE MATERIALS

### A. Ductile Iron Piping and Fittings:

1. Unless otherwise shown or specified, all interior piping 4 inches in diameter or larger shall be ductile iron conforming to AWWA C151.
2. Interior piping shall be minimum Special Class 53 with a minimum rated working pressure of 250 psi.
3. Except where shown, interior pipe joints shall be flanged. Flanged joints shall conform to applicable flanged joint sections of AWWA C110 and C115 and shall be compatible with ANSI B16.1 Class 125. Flanges shall be cast or ductile iron.
4. Flanged gaskets shall be minimum 1/8-inch-thick rubber "ring" gaskets, not full faced gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerances.
5. Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked prior to finish painting with Sonneborn NP-1 by Sonneborn-Chem Rex, Inc., Sika FLEX 1-A, or equal.
6. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressures and installation conditions specified or shown.
7. Interior fittings shall be flanged and of ductile or cast iron. Flange fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
8. All ductile iron fittings shall be American, Clow, Griffin, Tyler, U.S. Pipe, or equal.
9. All flanged sections of pipe shall be made up in 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.
10. Interior pipe and fittings shall be cement-mortar lined and asphaltic coated inside and shall be shop primed outside. Submerged pipe and fittings shall be cement mortar lined and asphaltic coated inside and asphaltic coated outside. Cement-mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Shop priming with products equal to and compatible with those listed under painting in Division 9 of these specifications shall be provided.
11. All ductile iron piping and fittings designated for air shall be unlined and shall receive exterior coating as specified above.

### B. Copper Piping:

1. Copper piping shall conform to the requirements of the "Specifications for Seamless Copper Water Tube," ASTM B88.
2. Unless otherwise shown or specified, all interior or aboveground potable and nonpotable water supply piping 3 inches in diameter or smaller shall be Type K hard copper.
3. Fittings shall be soldered or sweated on and shall be of cast bronze or forged brass containing 85% copper.
4. All underground water supply piping 3 inches or smaller shall be Type K soft copper with compression fittings. Joints shall not be used under floor slabs.
5. Shutoff valves shall be placed on each branch for all underground, aboveground, or interior piping.
6. Pump vent and drain lines, manometer lines and lines to pressure gauges above the floor shall be rigid, Type K, hard copper. An ample number of unions shall be provided for disassembling. Pump vents shall be valved.
7. Natural gas regulator vents shall be Type K hard copper 1/2-inch-diameter minimum.

- C. Galvanized Iron Piping:
1. Where shown or specified, all galvanized piping shall be Schedule 40 galvanized iron pipe with galvanized malleable iron fittings.
  2. An ample number of unions shall be provided for disassembling pipe.
  3. Pipe shall conform to the "Specifications for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses," ASTM A53.
- D. PVC Piping:
1. All chemical feed lines shall be constructed of PVC.
  2. PVC shall conform to ASTM D1784, Class 12454-B.
  3. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467 and for threaded ASTM D2464.
  4. All piping shall be approved for use by the National Sanitation Foundation.
  5. All pipe delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent weld, except where flanges are shown on the drawings or where transition to another pipe material is required. Pipe shall be installed in compliance with ASTM D2321 except as otherwise specified herein.
  6. Schedule 80 PVC pipe may be used for plumbing vents.
- E. Gas Piping:
1. In general, gas piping shall conform to all state, local, and utility codes pertaining to natural gas service or requirements.
  2. Aboveground natural gas piping shall be Schedule 40 black steel pipe (ASTM A53 with 150 psi steel welded fittings or 150 psi malleable iron screwed fittings).
  3. Gas piping 1 1/2 inches and larger may be welded.
  4. Piping 1 1/4 inches and smaller shall be screwed.
  5. Exposed gas piping 3 inches and larger shall be ductile iron as specified.
  6. 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. Seamless welding fittings shall be used for all welded piping. Screwed joints need to be sealed with Teflon (tape or paste).
  7. All natural gas piping shall be installed in accordance with State and local gas codes, and the National Fuel Gas Code, NFPA No. 54.
  8. In addition to the above requirements, no interior gas piping shall be concealed, all changes in direction shall be made with fittings, no pipe bends will be allowed, all pressure regulating valves shall be vented to the outside, and piping shall grade 1/4 inch per foot to drip pots, traps, or accumulator at low points.
- F. Gas Cocks:
1. Crane, Walworth, Jenkins, Nibco, Milwaukee, or DeZurik are acceptable manufacturers.
  2. One-half inch to 4-inch DeZurik Figure 425 gas valve, cast iron body, screwed or flanged ends, bronze bearings, bronze plug, and resilient seal ring for drop tight shutoff to 175 psig working pressure.
- G. Gas Safety Relief: Kunkle or Rego are acceptable manufacturers. ASME Standard for gas safety relief with stainless steel seat and disk.
- H. Gas Regulators: Fisher, Kunkle, or Rego are acceptable manufacturers. Regulation shall reduce gas pressure to scheduled pressure for equipment.

- I. Cast Iron Soil Pipe:
  - 1. Except as shown, all drainage, waste, soil, and vent piping shall be first quality, service grade cast iron hub and spigot pipe, tarred inside and outside, free of flaws and defects, and conforming to ASTM A74.
  - 2. Rubber gasket joints conforming to ASTM C564 may be used below ground. No hub joints may be used aboveground provided that they conform to the Plumbing Code.
  - 3. No bends shall be sharper than 1/8 or long sweep 1/4.
  - 4. Ends of all runs and stacks shall have cleanouts and screwed plugs. PVC pipe may be used for roof drain leaders, downspouts, and vent piping in buildings where allowed by Code.
  
- J. Drain, Waste, and Vent (DWV) Piping:
  - 1. All building drain, waste, and vent (DWV) piping and aboveground conductor, and Clearwater piping located in or within 2 feet of buildings or buried under slabs may be PVC pipe as specified herein or cast iron soil pipe as specified above.
  - 2. Sanitary and storm drain, waste, and vent piping shall be Schedule 40 PVC conforming to Class 12454-B, ASTM D1785, and ASTM D2665. Fitting patterns shall conform to ASTM D3311; primers shall conform to ASTM F656, and solvent cement shall conform to ASTM D2564.
  - 3. Sanitary and storm building sewers that penetrate exterior foundation walls shall be ductile iron from 2 feet beyond the exterior wall.
  - 4. Aboveground PVC shall not be used where smoke generation, noise transmission, or physical abuse/durability are an issue.
  
- K. Polyethylene Tubing: Chemical tubing shall be polyethylene tubing, unless otherwise shown or specified. All tubing bends, tees, adapters, and unions shall be black clear polypropylene, or 304 stainless steel compatible with the tubing and solution, or equal. Tubing inserts shall be used at all fittings. Tubing and fittings shall be rated for operating pressures of 120 psi, minimum. Tubing runs in excess of 10 feet shall be run in adequately supported minimum 2-inch ID Schedule 40 PVC conduits. Conduit runs shall be broken at all fittings and bends to allow easy access to interior tubing. Conduit shall be supported as specified for PVC piping.
  
- L. Flexible PVC Piping:
  - 1. Flexible hose connections between chemical storage tanks and rigid chemical feed piping shall be Series K3280, Reinforced PVC Flexible Connection Hose as manufactured by Kuriyama of America, Inc., or equal.
  - 2. PVC hose shall have a maximum working pressure of 125 psi at 150°F.
  - 3. Hose shall be clear and compatible with chemicals being used.
  - 4. Hose shall be certified under NSF/ANSI standard 61.
  - 5. All hoses shall be provided with suitable fittings and connectors to connect hose to tanks and rigid piping.

## 2.03 VALVE MATERIALS

- A. Swing Check Valves:
  - 1. The check valves in the well pump discharge lines shall be a swing check valve with outside lever and weight equipped with an air cushion chamber to cushion the closing of the valve disk. The valve shall be manufactured in accordance with AWWA C508.
  - 2. The swing check valves shall be constructed with a heavy cast iron or cast steel body, a bronze or stainless steel seat ring, an extra heavy noncorrosive shaft for attachment

- of lever and necessary weights to close valve, and a complete noncorrosive air cushion chamber.
3. The valve shall be tight seating and shockless in operation.
  4. The seal ring shall be renewable and shall be securely held in place by a threaded joint.
  5. The air cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any hammering action.
  6. Shock absorption shall be by air, and the chamber shall be so arranged that the closing speed can be adjusted to meet the service requirements.
  7. The valve disk shall be of cast iron or cast steel and shall be suspended from a noncorrosive shaft which shall pass through a stuffing box to be connected to the chamber on the outside of the valve.
  8. Provide a NEMA 4 limit switch to indicate when valve is closed. Limit switch activation shall be readily adjustable.
  9. The GA Industries, Inc., Fig. 250-D is representative of the installation desired. Valves that require external hydraulic connections or power will not be approved.
- B. Small Check Valves: Check valves in other than cast iron lines shall be Milwaukee Valve 510, Nibco T-433, screwed end bronze swing check for water, air, and gas. Provide unions to allow for ease of removal.
- C. Butterfly Valves:
1. General:
    - a. Except as otherwise specified or shown on the drawings, shut-off valves in lines 4 inches in diameter or larger shall be butterfly valves.
    - b. Butterfly valves shall be AWWA C504, short body, Class 150B. Provide certified drawings by manufacturer and affidavit of compliance.
    - c. Valve bodies shall be cast iron (ASTM A126, Class B) or ductile iron ASTM A536. Valves shall be flanged interior exposed and mechanical joint underground and conform to ANSI B16.1 Class 125.
    - d. Valve shaft shall be stainless steel.
    - e. Valve disk shall be cast iron.
    - f. Valve seat shall be constructed of synthetic rubber compound and shall be recess mounted and bonded in the valve body or attached to the disk. Seat shall be mechanically attached to the valve body or seat with screws, bolts, clamping rings, or similar devices.
    - g. Valve shaft bearing shall be self-lubricating Teflon, nylon, or bronze.
    - h. Shaft seals shall have split V-type packings that are replaceable without removing the valve from the line.
  2. Standard Operators:
    - a. Except as noted below, butterfly valves shall be equipped with top-mounted handwheel operators with totally enclosed, sealed, and lubricated gear boxes.
    - b. The rated torque capability of each operator shall be sufficient to seat, unseat, and hold any valve disk position with the maximum pressure differential across the valve without creep or fluttering.
    - c. Exposed valves shall be equipped with handwheels and valve disk position indicators and shall be equipped with field adjustable mechanical stop-limiting devices.
    - d. Provide chain wheels for valves located greater than 6 feet above the floor. Provide stainless steel hooks to hold chains out of walking paths.

- D. Air Release Valve:
1. The air release valves on air stripper inlet lines shall be 1-inch APCO Model #50 Val-Matic No. 15A, or equal.
  2. The valve assembly shall be installed as shown on drawings.
  3. CONTRACTOR shall run 1/2-inch pipe from the top of the valve to nearest hub drain. Screen end of pipe.
- E. Air Release Vacuum Relief Valve:
1. The deep well service combination air and vacuum release valve shall be 2-inch APCO Model 144DAT Val-Matic No. 102ST, or equal.
  2. The valve assembly shall include a discharge throttling valve, water diffuser, and 2-inch gate valve on the valve inlet.
  3. CONTRACTOR shall run 2-inch pipe from the top of the valve to nearest hub drain. Screen end of pipe.
- F. Solenoid Valves: Except where otherwise shown or specified, solenoid valves for water services shall be normally closed, 2-way pilot operated, slow closing solenoid valves, ASCO Red-Hat II 8221 Series, or equal. Valves on seal water systems shall fail open. Valve shall be brass body with Buna-N disk. Enclosure shall be rated for NEMA 4X in rated areas. Valve shall be operated on 120 VAC, 60 Hz power supply. Valve shall be rated for a maximum operating pressure differential of 150 psi. Unit shall be CSA certified and UL listed.
- G. Miscellaneous Valves:
1. Shut-off valves in PVC piping shall be 150 psi PVC ball valves, Chemtrol TU Series Tru-bloc, Walworth Series 8927, Wallace & Tiernan, or equal. Valves in Sodium Hypochlorite (SH) piping shall be Chemtrol "Bleach Ball Valve" series, or equal, and shall be fitted with a relief port from center to high pressure side of valve.
  2. Y-strainer in chemical lines shall be transparent PVC, Asahi, or equal, Trueunion strainer. Provide 20 mesh PVC screens. Strainers used for hypochlorite service shall have Teflon O-rings.
  3. Y-strainer in water lines shall be bronze, Watts, or equal. Provide 20 mesh 304 stainless steel screen.
  4. Provide unions for ease of valve removal. For transition from PVC to metal, use Chemtrol transition unions.
  5. For pressures <80 psi, provide 1/2-inch chrome-plated smooth end sampling cock, Zurn Z-80401, or equal. For pressures >80 psi, provide 1/2-inch satin brass smooth end sample cock, Conbraco 26-314, or equal. Alternatively, CONTRACTOR may substitute a shutoff valve with copper tube. Copper tubes and sample taps shall discharge over hub drain.
  6. Shut-off valves in potable water lines smaller than 1 inch shall be Milwaukee 1131 (threaded) or Milwaukee 1169 (solder joint) Nibco T-134 (threaded) or Nibco S-134 (solder joint) or equal, bronze 300 psi gate valves.
  7. Corporations in potable water lines (3/4 inch or 1 inch) shall be Mueller H 15008 compression-type fittings, or equal.
  8. Exterior hose valves shall be Woodford Model 65, Ken-Ray Model 120, or equal freezeless wall hydrants with integral Nidel 34HA vacuum breaker, permanent valve seat, and brushed chrome exterior face with 3/4-inch garden hose threads. Provide separate interior shut-off valves as specified herein.
  9. Interior hose valves shall be Woodford Model 24, Jenkins 112, or equal, 3/4-inch garden hose thread. Interior hose valves on the potable water system shall be equipped with approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal.

2.04 COUPLINGS AND RESTRAINT MATERIALS

- A. Pipe Coupling: Pipe couplings identified on the drawings shall be equal to Dresser Type 38, Rockwell 411, or equal coupling. CONTRACTOR shall provide tension ties and tie ears as shown on the drawings and specified herein.
- B. Restrained Flanged Adapter: Restrained flanged adapter identified on the drawings shall be EBAA Iron Series 2100, or equal.
- C. Tension Ties:
  - 1. All tension ties, rod ties, and control rods shall be provided to resist a minimum 150 psi (250 psi surge allowance) pressure in the pipe line.
  - 2. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary with dimensions as shown on the drawings.
  - 3. Rods shall be provided with nuts and washers on both sides of tie ears.
  - 4. All nuts shall be carbon alloy steel conforming to A563, and washers shall be hardened steel conforming to ASTM F436.
  - 5. Rods shall be ASTM A36 steel at a minimum.
  - 6. Tie rods shall be equally spaced around pipe.
  - 7. The following tables lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

Pipe Size (Inches)	250 psi Pressure	
	Minimum Number	Minimum Size (Inches)
4 to 10	4	5/8
12	4	3/4
14	4	7/8
16	4	1
18	4	1 1/8
20	4	1 1/4
24	4	1 1/2
30	7	1 3/8
36	8	1 1/2
42	12	1 1/2
48	22	1 1/4
54	22	1 3/8

- D. Mechanical Seals: Mechanical seals shall be 316 stainless steel link seal. 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.

2.05 MATERIALS–NONSHRINK MORTAR

- A. Nonshrink mortar shall be All-Crete as manufactured by Concrete Products, Inc., Woodland, California; Speed Crete as manufactured by Tamms Industries Co., Itasco, Illinois; or equal. Nonshrink mortar shall be placed in accordance with manufacturer's recommendations.

## 2.06 EQUIPMENT–PRESSURE GAUGES

- A. Gauges are to be aluminum 6-inch ANSI B40.1, Grade 2A bourdon gauges and be equipped with properly sized Ray pressure snubbers and brass shutoff valves.
- B. Gauges shall be accurate to  $\pm 1/2\%$  of scale range.
- C. Gauges shall be Terice No. 500-X Series, Ashcroft Duragauge, or equal.
- D. Gauges shall be as follows:
  - 1. Well pump discharge gauge graduated in psi, range 0 to 30 psi.
  - 2. Booster pump discharge gauge graduated in psi, range 0 to 200 psi.

## 2.07 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory 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 9. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) 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 equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. (For equipment surfaces in contact with potable water, primer shall be 140-1255 Beige Pota-Pox Primer and shall be NSF-approved.) Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify.
- B. Factory standard prime finish for valves and meters is acceptable if material is compatible with epoxy finish coat specified in Division 9. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Unless shown otherwise, underfloor piping shall clear floor slabs and footings by a minimum of 6 inches.
- B. Support:
  - 1. All interior or exposed pipelines, except in chemical feed rooms, shall be securely supported by adjustable metal saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile.
  - 2. Exposed piping in chemical feed rooms shall be supported with a plastic support system, Aickinstrut Series V, or equal.
  - 3. Strap hangers, tin clips, or U-hooks will not be acceptable.
  - 4. Piping shall be supported, even though not shown on the drawings, with base fittings and concrete pads when bottom of pipe is less than 6 inches above the floor, with Anvil 264, B-line, or equal, adjustable pipe saddle stand with floor flange to 6 feet

- above the floor, and with Grinnell or equal adjustable iron or heavy steel pipe hangers with supporting clamps or inserts more than 6 feet above the floor.
5. In general, the maximum spacing of supports shall not exceed 10 feet on centers unless approved by ENGINEER.
  6. Plumbing system shall be installed with hangers and supports in accordance with the Plumbing Code.
  7. Stainless steel supports shall be used in submerged locations.
  8. Insulation saddles shall be used at supports of insulated piping. 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.
  9. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties.
  10. The weight of the piping shall be supported independently of connected equipment.
  11. 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.
  12. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
  13. 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, 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 9.
  14. The following maximum spacings shall be provided for supports:

## MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

Nominal Pipe or Tube Size	Copper Tubing		Ductile Iron (See Note 1) ft	PVC Pipe (See Note 2) ft
	Water Service ft	Vapor or Air Service 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
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 manufacturer's recommendations.

15. 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.

16. 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.

C. 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.
3. If the concrete members are to be watertight, the annular space around the pipe shall be caulked with lead wool or sealed with an approved mechanical seal.
4. For copper pipe provide an elastomeric sleeve on pipe where it passes through walls or slabs.
5. Where pipes pass through a roof, they shall be run through an approved roof penetration with flashing and counter flashing.
6. Where pipes pass through nonwatertight walls, the annular space shall be grouted full.
7. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation, and the annular space shall remain open.
8. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the wall and provide a wall sleeve or wall pipe.
9. Space between wall sleeve or wall pipe and concrete shall be filled with nonshrinking mortar.
10. The annular space between the wall sleeve and pipe shall be sealed with an approved mechanical seal.
11. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and grouted full (walls), remain open (floors).
12. Plug abandoned pipes and wall pipes, after pipe and fitting removal, flush to the concrete surface with nonshrinking mortar, or as otherwise approved to achieve a watertight seal.
13. 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.
14. All openings for pipe work shall be neatly patched in a workmanlike manner.

D. Layout:

1. 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.
2. 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.
3. Piping shall not interfere with headroom or clear floor space.
4. Do not install gas pipe in a ventilation air plenum.
5. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside. Terminate with a screened vent cap and locate according to gas utility regulations.
6. Unless otherwise shown, small water piping shall be concealed in (except reinforced concrete walls) walls placed in piping pits, above suspended ceilings, or under floors where possible, or as shown on the drawings.

7. Pipes under floors shall have a minimum of 6 inches of sand cover.
8. 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.
9. 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 shut off valve at each appliance.
10. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
11. 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.
12. Valves shall be located on all branches of water supply lines where shown on the drawings. Position valves to facilitate access and operation.

### 3.02 FIELD QUALITY CONTROL

#### A. Site Tests:

1. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price bid.
2. 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.
3. All piping shall be flushed or blown out after installation prior to testing.
4. 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.
5. 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.
6. Test Requirements:

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
Chlorine Solution	100	Water	Zero
Chlorine Gas Under Vacuum	15 inches Hg	Vacuum	Zero
Fluoride Solution	100	Water	Zero
Potable Water	150	Water	"A"
Natural Gas Piping	"B"	"B"	"B"
Cooling Water	150	Water	"A"

7. Leakage allowance Designation "A" shall mean zero leakage for unburied pipe and shall be not more than 0.002 gallon per hour per inch diameter per 100 feet of buried pipe for compression or solder joint pipe.

8. Natural gas piping, test pressure, test medium, and leakage allowance designation "B" shall be tested in accordance with local gas utility requirements and leakage allowances.
9. Tests for all gravity sewers shall be as follows: Pipe will be plugged at its downstream end, and water will be placed inside the pipe to a minimum head of 10 feet. Water shall be held for 15 minutes without dropping. No leakage is allowed.

### 3.03 CLEANING AND DISINFECTION

- A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the system before it is put on line.
- B. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Lump Sum Bid. Copies of test results shall be submitted to OWNER and ENGINEER.
- C. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- D. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.

END OF SECTION

SECTION 15195  
EQUIPMENT IDENTIFICATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Nameplates.
  - 2. Labeling tags.
  - 3. Wire and cable markers.
  - 4. Pipe markers.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.
- B. Provide schedule for nameplates and labeling tags for shop drawings. Reference drawings for type used.

PART 2–PRODUCTS

2.01 NAMEPLATES

- A. Type “A” Nameplates:
  - Use: Fans  
Unit heaters  
Blowers  
Well pumps  
Booster pumps  
Airstripper units
  - Size: 4 inch by 4 inch
  - Material: 3-layer laminated Micarta
  - Background Color: Black
  - Character Color: White
  - Character Size: 2 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

## 2.02 LABELING TAGS

- A. Labeling Tags:  
Use: Field mounted devices (valves, limit switches, etc.)  
Size: 1 inch by 3 inch  
Material: 1/32-inch-thick stainless steel  
Character Size: 1/4 inch  
Engraving: As requested by ENGINEER

## 2.03 WIRE MARKERS

- A. Wire markers shall be permanently attached wrap around adhesive, sleeve or heat shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wrap around 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. Self-Adhesive Pipe Markers (Labels): Vinyl: Factory fabricated vinyl, 0.13 mm (5 mil) thick, preformed to fit around pipe or pipe covering.
- B. Color and Text:  
1. Piping: Shall be in accordance with ASME A13.1 (see table).  
2. Gas Piping: NFPA 99C.

COLOR CODE CHART

Material Properties	Examples	Letter on Field Color
Inherently Hazardous Materials	Chemical	Black on Yellow
Low Hazard Liquids/Gases	Drinking Water, Sanitary Drain, Natural Gas, and Cooling Water	White on Green
Materials for Fire Suppression	Fire Protection Water and Sprinkler Water	White on Red

- C. Identify fluid being conveyed, and include flow direction arrow (as indicated).  
1. Include flow direction arrow.  
2. Language: English.  
3. Lettering: Size and color to ASME A13.1. See chart below.

PIPE MARKER SIZE CHART

Outside Pipe Diameter (including covering)	Minimum Length of Label Field Color	Minimum Height of Letters
3/4 inch to 1 1/4 inch	8 inch	1/2 inch
1 1/2 inch to 2 inch	8 inch	3/4 inch
2 1/2 inch to 6 inch	12 inch	1 1/4 inch
8 inch to 10 inch	24 inch	2 1/2 inch
over 10 inches	32 inch	3 1/2 inch

## 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 stainless steel screws or sticky-back adhesive.
- D. Affix labeling tags with permanent bonding cement or locking wire ties. 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.
- F. 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.

### 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 to manufacturer's instructions.
- B. Identify piping, concealed or exposed. Include service, flow direction, and pressure.
- C. Provide vinyl self-adhesive pipe markers.
- D. Install in clear view and align with axis of piping.
- E. Locate identification at maximum 20 feet 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.

END OF SECTION

## SECTION 15250

### MECHANICAL INSULATION

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Insulation for mechanical and process piping. All new and existing cold and hot potable and nonpotable water; roof drains; exposed to view or above suspended ceilings in buildings shall be insulated with pre-formed pipe insulation. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. See Section 01300–Submittals for shop drawing submittal procedures.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. Except as otherwise specified, insulation shall be manufactured by the following:
  - 1. Schuller International, Inc.
  - 2. Owens Corning.
  - 3. Knauf.
  - 4. Armstrong.
  - 5. Johns Manville
  - 6. Or Equal.

##### 2.02 PIPE INSULATION

- A. All pipe covering, jackets, duct insulation, vapor barriers, adhesive, and mastics shall have a flame spread rating of 25 or less and a smoke-developed rating of 50 or less in active return or supply air plenums. Insulation in all other areas within the building shall have a flame spread of 25 or less and a smoke-developed rating of 150 or less. Test method shall be ASTM E84.
- B. Water Piping: All new and existing hot and cold water piping, fittings, valve bodies, and flanges shall be covered with 1-inch glass fiber (K-factor of 0.25 at 75°F mean). Provide 30 mil PVC jacketing, fitting covers, and end caps. Color shall be selected by OWNER.
- C. Roof Drains: Roof drain bodies, horizontal roof leaders shall be covered with 1-inch glass fiber (K-factor of 0.25 at 75°F mean). Provide 30 mil PVC jacketing, fitting covers, and end caps. Color shall be selected by OWNER.
- D. Air Piping: All interior air piping shall be insulated including pipe, fittings, and intake and discharge silencers. Interior intake, intake silencers, and discharge piping shall be

insulated with Mansville Micro-Lok, or equal insulation, 2 inches thick with all purpose (AP) jacket. Provide vapor barrier, self-sealing lap, and butt strips. One-piece rigid premolded fiberglass, 4 pounds per cubic foot density, suitable for temperatures up to 250°F shall be provided. Provide one-piece premolded fitting covers, PVC covering with fiberglass insert, Manville Zeston, or equal.

- E. Piping in Slabs and Walls: All new cold and hot water piping, nonpotable water, injector water, and seal water supply inside concrete slabs or inside masonry walls shall be insulated with Armstrong Armaflex II, or equal, 1/2 inch thick.
- F. ADA Accessible Lavatory Insulation: Provide Truebro, Inc. Lav-Guard, or equal, under sink piping cover. Piping cover shall meet applicable ADA requirements. The p-trap, angle valve assemblies, supply piping, and tailpiece shall be covered with the molded vinyl, antimicrobial pipe cover. Cover shall be secured with flush reusable fasteners; angle stop shall have locking access cover.
- G. Buried Pipe: Rigid insulation shall be provided over all buried piping where the depth of cover over the pipe is less than 5 1/2 feet. Width of the insulation varies with depth of piping below the ground surface as follows, except minimum width of insulation shall be at least 3 times the pipe diameter.

Depth of Piping (ft)	Minimum Width of Insulation (ft)			
	Zone A	Zone B	Zone C	Zone D
2.5	6	7	9	10
3.0	5	6	8	10
3.5	4	5	7	9
4.0	3	4	6	8
4.5 to 5.5	2	3	5	7

- H. Rigid insulation over buried piping shall be minimum 2-inch-(2.5 inches for Zone D) thick extruded polystyrene closed cell rigid board with continuous skins on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 7.5. Rigid insulation shall be Styrofoam Square Edge by the Dow Chemical Company; Foamular 250 Polystyrene Insulation by UC Industries, or equal.
- I. Rigid insulation shall be installed as recommended by the manufacturer and according to details Drawing 01-975-75A bound at the end of these specifications.

**PART 3-EXECUTION**

**3.01 INSTALLATION**

- A. All insulation shall be applied in strict accordance with the manufacturer’s written recommendations.
- B. All pipe insulation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation, or with “Zeston”-type, pre-molded PVC fittings installed in accordance with the manufacturer’s instructions. Fittings are to be finished with 8-ounce glass mesh

and mastic (use breather mastic on systems operating above 50°F; a vapor barrier mastic on systems operating from 50°F down). Jackets on pipe insulation may be stapled using outward clinch staples spaced 3 inches apart at least 1/4 inch in from the lap edge on systems operating at 50°F and above; below 50°F and on roof drain lines, the laps are to be vapor sealed using self-sealing lap, lap-seal tape gun, or adhesive. All insulation ends are to be tapered and sealed regardless of service.

- C. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers are to be sized large enough to be installed over the outer surface of the insulation. Load distributing corrosion-resistant metal shields shall be installed around the lower 1/3 circumference of the insulation. For each pipe hanger, provide a half-round, 12-inch-long hanger block at the bottom half of the pipe in place of the fiberglass insulation. The blocks shall be molded foam glass insulation. Shields shall be 16 gauge. Shields shall be 12 inches long.

END OF SECTION

## SECTION 15290

### HEATING, VENTILATION, AND AIR CONDITIONING INSULATION

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Pipe insulation.
  - 2. Ductwork insulation.
  - 3. Equipment insulation.
  - 4. Acoustical duct lining.
  - 5. Jackets.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM E84—Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM C533—Specification for Calcium Silicate Block and Pipe Thermal Insulation.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300—Submittals.

#### PART 2—PRODUCTS

##### 2.01 MANUFACTURERS

- A. Acceptable manufacturers are Owens-Corning, Knauf, or Johns Manville.

##### 2.02 PIPE INSULATION

- A. Polyisocyanurate insulation shall be closed cell type, 2 pcf density with a “k” factor of 0.19 at 75°F mean temperature. Insulation shall cover piping fittings, valves, and flanges completely with thickness as specified.

##### 2.03 DUCT INSULATION

- A. Rigid-type duct insulation shall be 3-pound density, rigid insulating board. Thermal conductivity shall be not more than 0.23 at 75°F mean.

##### 2.04 ACOUSTICAL DUCT LINING

- A. Acoustical duct lining shall be Johns-Manville “Lina-Coustic,” Knauf duct liner “M,” or Owens-Corning “Aeroflex” duct lining, minimum 1.5-pound density with hard face to the air stream.

## 2.05 JACKETS

- A. PVC jackets (PVJ) shall be 0.02-inch thickness ultraviolet-inhibited white glass PVC film.
- B. Foil scrim jackets (FSJ) shall be glass fiber-reinforced foil kraft laminate. Jacket shall be factory-applied to the insulation.
- C. Self-adhering jackets (SAJ) shall be VentureTape VentureClad 1577CW, or equal. Jacket shall be 5-ply, self-adhering laminated waterproofing with reflective aluminum foil providing zero permeability. Jackets located in corrosive locations shall be VentureTape VentureClad 1574CW-H, or equal. Jackets located in GMP locations shall be VentureTape VentureClad 1577CW-T, or equal.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. All insulation shall be applied in accordance with manufacturer's recommendations. Destructive methods such as sheet metal screws are not acceptable.
- B. Pipe Insulation:
  - 1. All pipe insulation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation, or with "Zeston"-type, pre-molded PVC fittings installed in accordance with the manufacturer's instructions. Fittings are to be finished with 8-ounce glass mesh and mastic (use breather mastic on systems operating above 50°F; a vapor barrier mastic on systems operating from 50°F down). Jackets on pipe insulation may be stapled using outward clinch staples spaced 3 inches apart at least 1/4 inch in from the lap edge on systems operating at 50°F and above; below 50°F and on roof drain lines the laps are to be vapor sealed using self-sealing lap, lap-seal tape gun, or adhesive. All insulation ends are to be tapered and sealed regardless of service.
  - 2. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers are to be sized large enough to be installed over the outer surface of the insulation. Load distributing corrosion-resistant metal shields shall be installed around the lower 1/3 circumference of the insulation. For each pipe hanger, provide a half-round, 12-inch-long hanger block at the bottom half of the pipe in place of the fiberglass insulation. The blocks shall be fiberglass insulation. Shields shall be 16 gauge. Shields shall be 12 inches long.
- C. Ductwork Insulation (Rigid-Type):
  - 1. Brush on heavy coat of MEI Eco-Mastic 55-50, or equal, over first layer of canvas, embed second layer canvas mesh and smoothen. While still wet, brush on finish layer of Sealfas, or equal.
  - 2. Provide finished edges at all access doors and ends of insulation.
  - 3. Provide additional insulation trim pieces over flanged ductwork joints to completely insulate and seal to the thickness specified.
  - 4. Flexible connections from ducts to HVAC equipment shall not be insulated.

- D. Acoustical duct lining shall be fastened to the inside of the ductwork on all surfaces with pins and fire-resistive adhesive. Adhere to duct surface with a minimum of 100% coverage of Benjamin Foster 81-99 fire-resistive adhesive. All transverse edges of lining shall be buttered with a fire-resistive coating similar to Benjamin Foster 30.70 to prevent erosion by the air stream. Edge treatment and lining attachment shall be in accordance with SMACNA "Flexible Duct Liner Installation Manual."

### 3.02 PIPE INSULATION THICKNESS SCHEDULE

Type of System	Jacket	Type	*Runouts Up to 2-IN (inch)	1 1/2-IN and Less (inch)	Greater than 1 1/2-IN (inch)
Cooling Water Supply and Return	PVJ	Polyisocyanurate	1.5	1.5	1.5

\* Runouts are extensions to individual terminal units not exceeding 12 feet in length.

### 3.03 DUCT INSULATION THICKNESS SCHEDULE

Service	Insulation Type	Jacket	Thickness (Inch)
Exposed Supply Ducts in Mechanical Rooms	Rigid Fiberglass	FSJ or SAJ	2.0
Exhaust and Relief Ducts from Louver and/or Gravity Roof Ventilation to 12 Inches Beyond Damper	Rigid Fiberglass	FSJ or SAJ	2.0
Intake and Exhaust Damper Frames	Rigid Fiberglass	FSJ	2.0
Accoustical Duct Lining in Blower Room	Rigid Fiberglass	-	2.0

END OF SECTION

## SECTION 15300

### WATER BASED FIRE PROTECTION

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: There is one automatic fire sprinkler zone scheduled and outlined on the drawings. The zone connects to a sprinkler riser. The zone is a wet sprinkler system and begins with a zone control valve with tamper switch, flow switch, 1-inch inspectors test valve, and auxiliary drain valve.
- B. Provide complete fire protection systems that are compatible with the fire alarm system in accordance with the Factory Mutual Research Approval Guide. The fire protection system shall include all necessary piping, valves, controls, fittings, and hardware for each of the following buildings and the corresponding system types:

Building	Automatic Fire Sprinkler Zone
Well No. 15	Wet Pipe System

- C. Work under this section shall commence with a connection to the potable water service and all interior fire protection systems.
- D. CONTRACTOR may install additional piping and fittings and valves not shown on the drawings for testing purposes or for the convenience of the installation. Where such materials are installed, they shall comply with the specifications and shall be sized to be compatible with the system design. Remove such installed materials when they interfere with the design conditions or as directed by ENGINEER.
- E. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions. Where architectural features govern location of work, refer to architectural drawings. Check, verify, and coordinate work with drawings and specifications prepared for other trades. Include all modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.
- F. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 CODES AND STANDARDS

- A. Comply with requirements of Wisconsin Commercial Building Code, local Fire Chief or Fire Marshal, insurance underwriter, and applicable National Fire Protection Association (NFPA) Standards (latest editions).
1. ASSE 1015: Double Check Valve Backflow Preventers.
  2. NFPA 13: Installation of Sprinkler Systems.
  3. NFPA 25: Inspection, Testing & Maintenance of Water-Based Fire Protection Systems.
  4. NFPA 72: National Fire Alarm Code.

5. NFPA 231: General Storage.
6. Underwriters Laboratories Fire Protection Equipment Directory.
7. Current Factory Mutual Approval Guide.
8. Local and State Building, Mechanical and Fire Codes.

### 1.03 QUALITY ASSURANCE

- A. All plans and hydraulic calculations shall be signed and sealed by a registered architect, professional engineer, fire protection systems designer, or signed and dated by the contractor responsible for the design and installation of the system; in accordance with the Wisconsin Administrative Code.
- B. CONTRACTOR shall be licensed by the State of Wisconsin for installation of sprinkler fire protection systems.
- C. CONTRACTOR(s) shall submit prequalification evidence of at least 5 projects of comparable size and scope successfully completed with their bid. Distortion or misrepresentation of qualification evidence may result in contract cessation.
- D. UL & FM Compliance: Unless otherwise indicated, all products shall be listed in the latest publication of Approval Guides for Underwriters Laboratory and Factory Mutual for the service intended. All system components shall be in conformance with applicable NFPA Standards.
- E. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.

### 1.04 DESIGN CRITERIA

- A. Available water supply data (preliminary) is as follows:

Hydrant ID	Location	Date	Time	Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)
H-3 P6430	3900 E. Washington	6/15/2012	10:56 A.M.	1,445	84	80

- B. Water test data is preliminary for bidding purposes. CONTRACTOR shall perform flow tests prior to preparation of design calculations. Test shall be representative of high water use periods.
- C. Design fire protection systems in accordance with codes, standards, and regulations noted above. Design sprinkler systems for the most hydraulically remote area based on the following.

Zone Description	Area (sf)	Sprinkler System Type	Area of Sprinkler Operation (sf)	Sprinkler Density (gpm/sf)	Occupancy Classification	Sprinkler Rating (°F)	Total Combined Inside/Outside Hose (gpm)
Zone 1	2,516	Wet	3,000	0.17	OH Gr11	165	250

- D. Maximum head spacing per NFPA 13, for each occupancy hazard indicated.
- E. Hydraulic Calculations: Sprinkler systems which shall be hydraulically designed must be designed a minimum of 10% or 10 psi, whichever is greater, below the available water curve.
- F. Hose Streams: Add indicated hose streams to all sprinkler zone hydraulic calculations at the base of the riser.
- G. Water velocity throughout the entire system shall not exceed 20 feet per second.
- H. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows.
- I. Fire protection system components shall be rated for minimum operating pressure of 175 psig.
- J. Corrosive Atmosphere(s): Corrosive atmospheres include the following: Chemical storage rooms.

#### 1.05 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300–Submittals. The provisions outlined in this section shall expand and supplement the requirements specified in Division 1. Where additional or differing requirements are indicated, the more stringent provision applies.
- B. Submittals are to be sent to and approved by the insurance underwriter, local Fire Chief, or Fire Marshal prior to submitting to ENGINEER. Include copy of approval letters in submission to ENGINEER.
- C. Submit fire protection system drawings at minimum scale of 1/8-inch = 1 foot 0 inches for floor plans and 1/2 inch = 1 foot 0 inches for details. Drawings shall include water supply locations and size, piping layout and size, sprinkler locations and type, piping and fire protection specialty locations and type, valve stem movement, hanger locations and type, lighting, ductwork, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference points, design areas, hose locations, and discharge densities. Include incidental details not usually shown or specified but necessary for proper installation and operation. Submittal drawings shall be stamped by the designer.
- D. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all fire protection installations. Indicate locations where space is limited and where sequencing and coordination of installations are of importance to other trades.
- E. Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet and detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations. Include graph illustration of water supply, hose demand, and sprinkler demand.
- F. Furnish product submittals for all equipment and systems. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number as indicated in the Contract Documents. Where more

than one item appears on a manufacturer's catalog sheet, the item(s) to be used shall be indicated by a red marking or an arrow. Include wiring diagrams of electrically powered equipment.

- G. Material submittals shall include all items listed in the product section and all additional items necessary to provide a complete installation.

#### 1.06 OPERATING AND MAINTENANCE MANUALS

- A. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the Division 1 requirements, include the following information:
  1. Copies of all approved submittals along with approval letters.
  2. Manufacturer's wiring diagrams for electrically powered equipment.
  3. Records of tests performed to certify compliance with system requirements.
  4. Certificates of inspection by regulatory agencies.
  5. Parts lists for equipment and specialties.
  6. Manufacturer's installation, operation and maintenance recommendations for equipment and specialties.
  7. Valve types and locations.
  8. Warranties
  9. Additional information as required for records and maintenance of system.
  10. Lubrication instructions, including list/frequency of lubrication.
  11. Provide two copies of NFPA 25 current for the year the system is installed.

#### 1.07 AS-BUILT DRAWINGS

- A. Maintain at the site an up-to-date marked set of "as-built" drawings which shall be corrected and delivered to ENGINEER upon completion.
- B. Upon completion of the Work and final acceptance by the local authority, CONTRACTOR shall submit record drawings to OWNER and ENGINEER under the provisions of Division 1.

#### 1.08 TRAINING

- A. Instruct OWNER's personnel in the proper operation, maintenance and testing of systems and equipment provided as part of this project. Include not less than 4 hours of instruction using the Operating and Maintenance Manuals and Record Drawings during this instruction. Demonstrate testing, startup and shut down procedures for all equipment. All training to be during normal working hours. Videotape all instructions and provide OWNER with copy.

### PART 2—PRODUCTS

#### 2.01 FIRE PROTECTION PIPING

- A. Piping—Below Ground: Ductile iron pressure pipe, mechanical joint, Class 52, 150 psi working pressure, ANSI Standard A21.51. Ductile iron fittings, ANSI Standard A21.11. Include cement mortar lining, ANSI Standard A21.4.

B. Piping—Above Ground:

1. Steel Pipe: Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135. Threaded lightwall pipe and plastic pipe are not acceptable.
2. Pipe Wall Thickness: Schedule 40 for welded, rolled groove, cut groove and threaded. Schedule 30 for welded, rolled groove, 8 inches and larger cut groove, and 8 inches and larger threaded piping. Schedule 10 up to and including 6 inches for rolled groove and welded. 0.188 inches for 8-inch and 10-inch rolled groove and welded.
3. Fittings (2 inches and Under): Cast iron threaded fittings, Class 125/250, ASTM A126/ANSI B16.4. Malleable iron threaded fittings, Class 150/300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI B16.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable iron or ASTM A53 fabricated steel. Fittings on galvanized pipe systems shall be galvanized.
4. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
5. Finish: Hot-dipped zinc-coated (galvanized) finish on piping and fittings used in dry sprinkler or combined pipe systems, pre-action systems, piping exposed to weather, and piping exposed to corrosive environments where indicated in design criteria. Thread or cut groove hot-dipped zinc-coated pipe ends for fitting connections. Indoor dry standpipe systems supplied by fire department connection only may be black steel piping and fittings.

C. Unions and Flanges:

1. Unions, flanges, and gasket materials to have a pressure rating of not less than 175 psig.
2. Two-inch and Smaller Steel: 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.
3. Two and one-half-inch (2 1/2-inch) and Larger Steel: ASTM A181 or A105, Class 150, Grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full-face gaskets. Use ANSI B16.1 flat face flanges with full-face gaskets for mating with other flat face flanges on equipment. Provide galvanized flanges on galvanized piping.
4. Rigid or zero flex type couplings will be used when operating pressures may cause piping to move out of place or sway on hangers. Flexible couplings may be used where piping is properly braced or clamped into a grid position.

D. Mechanical Grooved Pipe Connections:

1. Mechanical grooved pipe couplings and fittings, as manufactured by Victaulic, Anvil, or equal may be used with cut steel pipe. Couplings and fittings to be malleable iron ASTM A47 or ductile iron A536 with painted finish. Fittings used on galvanized steel pipe to have galvanized finish, ASTM A153.
2. All mechanical grooved pipe material including gaskets, couplings, fittings, and flange adapters to be from the same manufacturer.
3. Gaskets shall be EPDM, ASTM D2000. Heat-treated carbon steel oval neck track bolts and nuts, ASTM A183 with zinc electroplated finish. Gaskets for dry systems to be flush seal or flush gap design.

4. "Pipeolets" or similar mechanically attached fittings will not be permitted as fittings. "Weldolets" welded to crossmains in fabrication shops will be permitted as a fitting to supply branch piping only, unless specifically approved for other applications.
5. Fittings and couplings must be suitable for the temperature and pressure involved. In no case is the final system to have a pressure rating of less than 175 psig.
6. Acceptable fittings and couplings are listed below, based on Victaulic figure numbers:
  - a. Couplings: Standard flexible couplings, Style 77; or lightweight couplings, Style 75. Reducing couplings are not acceptable.
  - b. Flanges: Flange adaptor, Style 741, except at lug-type butterfly valves where standard threaded flanges shall be used.
  - c. Fittings: Malleable or ductile iron elbows and tees of the manufacturer's standard line may be used in all sizes except bullhead tees will not be accepted. Mechanical-T Style 920 fittings with malleable iron housings may be used for up to 2-inch outlet size.

## 2.02 HANGERS, SUPPORTS, AND ANCHORS

- A. Comply with the requirements of applicable NFPA Standards. Hangers shall be UL-listed and FM-approved, unless otherwise specified.
- B. Riser clamps shall not protrude more than 2 inches beyond the edge of the hole. The riser clamps need to be only UL-listed, Grinnell figure 261 or approved equal.
- C. Below concrete construction, inserts, expansion cases, or Phillips-type shells shall be installed to support piping smaller than 6 inches. Concrete expansion anchors are to be Hilti Drop-in Anchor, Phillips concrete fasteners, or approved equal. "Kwik" bolts or similar concrete anchors are not permitted. Below concrete construction, inserts shall be installed for all piping 6 inches and larger. In lieu of inserts, expansion shields spaced no more than 10 feet apart may be installed in accordance with NFPA 13, Sections 2-6 and A-2-6.3.
- D. Corrosive Atmosphere Coatings: Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.
- E. Equipment Stands: Use structural steel members welded to and supported by pipe supports. Clean, prime, and coat with three coats rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

## 2.03 SPRINKLERS

- A. Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following manufacturers, determined to be equal by ENGINEER, will be accepted: Central Sprinkler Corporation, Reliable Automatic Sprinkler Co., Star Sprinkler Corporation, Viking Corporation, Victaulic, and TYCO.
- B. All sprinkler heads shall be UL-listed and FM-approved, fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2-inch discharge orifice except where greater than normal density requires large orifice.

- C. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location and as indicated. Provide ordinary temperature fusible link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where otherwise indicated.
- D. Listed corrosion-resistant sprinkler heads shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist. Sprinkler heads located in areas listed in design requirements shall be listed corrosion-resistant heads.
- E. Sprinkler Cabinets: Provide cabinets complete with required number of spare heads of each type and temperature rating and special wrenches in accordance with NFPA 13. Provide multiple cabinets as required. Cabinet shall be finished steel suitable for wall mounting with hinged cover and adequate space for required spare heads and wrenches. Coordinate cabinet location with OWNER's representative. Coordinate quantities with the authority having jurisdiction over the project.

## 2.04 VALVES

- A. Manufacturers: Kennedy, Milwaukee, Nibco, Stockham, Victaulic, Viking, and Watts.
- B. Line Control Valves 2 inches and Smaller:
  - 1. Ball Valves: Bronze 2-piece, threaded or sweat ends, standard port, blowout proof stem, chrome plated ball, glass reinforced seats, UL Approved, 250 psi rating.
  - 2. Butterfly Valve: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem. Equal to Milwaukee Model BB-SC01.
- C. Line Control Valves 2 1/2 inches and Larger:
  - 1. Gate Valve: UL-listed/FM-approved, outside screw and yoke (OS&Y) gate valves, 175 psig, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads. Valves shall be capable of being repacked under pressure with valve wide open. Equal to Nibco F-607-O.
  - 2. Butterfly Valve: Cast or ductile iron body butterfly valve, lug style or grooved, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, EPDM resilient seat, EPDM seals, nickel-plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use cap screws for removal of downstream piping while using the valve for system shutoff. Equal to Nibco LD3510-8.
- D. Test and Drain Valves:
  - 1. Threaded bronze globe-type with composition disc, 175 psi WOG. Valves shall be equal to Nibco KT-65 for piping assemblies built on site. Victaulic style 718 or 719 or equal may be installed to save space and assembly time.
  - 2. Drain Valves: UL listed, 3/4-inch minimum, two- or three-piece bronze body ball valve; threaded ends, chrome-plated bronze ball; glass-filled Teflon seat; Teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG. Low point drain valves shall have, in addition, a 1-inch brass nipple with 3/4-inch male hose threads and cap.

- E. Check Valves: Cast or ductile iron body, flanged or grooved ends, bolted cap, renewable bronze seat and disc, stainless steel clapper with a replaceable rubber seal (a rubber seal integral with the seat is not acceptable), and 175 psig suitable for installation in a horizontal or vertical line with flow upward. Valve equal to Viking Model D, Central Model 90. Provide 1/2-inch automatic drip drain or inlet to fire department connection check valve.

## 2.05 BACKFLOW PREVENTER

- A. Manufacturers: Ames, Conbraco, Febco, Watts, Beeco, Cla-Val, Wilkinson
- B. ASSE 1015 double check backflow preventer with two independent spring loaded check valves, two isolation ball or gate valves with normally open tamper switches, double wire leads, 4-valved test ports, and lockable valves. Constructed of bronze or epoxy-coated cast iron or stainless steel body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats, rated for 175 psig.

## 2.06 SPECIALTIES

- A. Supervisory/Tamper Switches:
  - 1. Manufacturer Potter, System Sensor, or equal.
  - 2. For O S & Y valve or butterfly valve installations, UL/FM listed/approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 and 6P enclosures.
- B. Flow Switches: Flow switches shall be UL-listed and FM-approved capable of transmitting a signal when the flow of water equals or exceeds the discharge of a single head. Unit shall be vane-type, with retard chamber and electrical characteristics compatible with fire alarm system. Provide flow switches for each riser.
- C. Local Alarm Bell:
  - 1. Manufacturer Potter, System Sensor, or equal.
  - 2. Weather proof electric alarm bell with red painted metal housing, mounting base and gong; solenoid operator; weather proofing O-ring seal and electrical characteristics compatible with alarm system.

## 2.07 ACCESSORIES

- A. Fire Department Connection: Manufacturers: All equipment shall be UL-listed and FM-approved by Elkhart Brass, Potter-Roemer, Badger-Powhatan, Croker Corp., J.W. Moon, and W.D. Allen.
- B. Pressure Gauges:
  - 1. Manufacturer: Ametek/U.S. Gauge Division, Ashcroft, Marsh, Taylor, H.O. Trerice, Weiss, Weksler.
  - 2. Cast aluminum, stainless steel or brass case of not less than 3.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor. bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale. Include bronze 3-way globe valve with plugged outlet for Fire Inspector's test gauge.

## PART 3—EXECUTION

### 3.01 GENERAL INSTALLATION

- A. Install pipe, fittings, equipment, and components in accordance with referenced standards, manufacturers' recommendations, recognized industry practices, and the authority having jurisdiction.
- B. General Coordination: Install all piping parallel to building walls and ceilings and at heights which 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. Coordinate locations of fire protection piping with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures, and grilles before installing piping.
- C. Where piping must be embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- D. Maintain piping, fittings, and fire protection system components in clean condition internally during construction. All material shall be kept at proper temperature to assure proper jointing. Pipe and fittings shall be corresponding materials when assembled.
- E. Provide clearance for access to valve and piping specialties to facilitate maintenance and repair or replacement.
- F. Pipe shall be hung from building members using concrete inserts or beam clamps. Provide anchors, expansion joints, swing joints, and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- G. Install sprinkler piping so that the system can be drained in accordance with NFPA 13. Where possible, slope to main drain valve. Slope dry pipe, deluge, and pre-action systems subject to freezing at minimum 1 inch per 10 feet on mains and 1 inch per 10 feet on branches. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve, inspector's tests, and auxiliary drains to grade or to air gap sewer receptor.
- H. Provide 3/32" min. thickness steel nailing plates behind or on either side of piping where the possibility of penetration from nails or drywall screws exists.
- I. Piping between pre-action or deluge valves and sprinkler heads and test/auxiliary drain piping shall be galvanized steel to retard or eliminate corrosion because of oxidation in these subsystems. Fittings shall match piping installed such as galvanized fittings on galvanized pipe. Provide dielectric fittings between dissimilar pipe materials.
- J. Mitered ells, notched tees, and orange peel reducers are not acceptable. Bushings and reducing couplings are not acceptable.
- K. Install auxiliary drains at all low points in the system and as required by the referenced standards. The drain shall consist of, as a minimum, a 1-inch ball valve, 1-inch brass nipple with 3/4-inch male hose threads, and cap.

- L. Fire Barrier Penetrations: Where pipes pass through fire-rated wall assemblies, partitions, ceilings, or floors, the fire rating integrity shall be maintained.
- M. Do not install piping within exterior walls.
- N. Do not route piping above transformers, panelboards, or switchboards included the required service space for this equipment, unless the piping is serving this equipment.
- O. Floor and Roof Protection:
  - 1. CONTRACTOR shall take extra precautions to protect the floors and roofs from oil spillage and dripping. Any operation, such as cutting and threading of pipe that can result in dripping of oil and thread cuttings, shall be done over a drain pan that will collect all drippings. Tarpaulins, plywood, or drop cloths shall be used around such piping to prevent workers from tracking oil over the area. Workers shall be cautioned about cleaning their feet. Any liquids, such as oil, that will be used in this work shall be kept in tightly stoppered containers; extreme care shall be used when charging equipment with these materials to avoid any spills.
  - 2. All residual matter deposited on floors, roofs, walls, and other surfaces because of the system installation shall be completely removed to the satisfaction of OWNER.

### 3.02 WELDED PIPE JOINTS

- A. Welded joints shall be made in a fabrication shop. No welding is allowed at the project site.
- B. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and the Wisconsin Commercial Building Code where applicable. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.
- C. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half the diameter of the main.

### 3.03 THREADED PIPE JOINTS

- A. Joints of threaded pipe shall be made by cutting pipe square and reaming inside. Ream ends of pipe to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly. Threads shall be cut so that exposed threads shall not exceed three. Exposed threads shall be coated with asphaltum. Use joint compound sparingly.
- B. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### 3.04 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools available for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

### 3.05 UNIONS AND FLANGES

- A. Install a union, flange, or grooved coupling combination at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union or grooved coupling combination connections on the equipment side of the valve. Concealed unions, flanges, or couplings are not acceptable.

### 3.06 HANGERS

- A. Support piping in accordance with NFPA 13, other sections of this specification, and in accordance with all state and local requirements.
- B. Provide hangers to support all piping in perfect alignment without sagging or interference, to permit free expansion and contraction, and to meet the requirements of NFPA 13. Strap hangers, wire hangers, or trapeze hangers will not be acceptable.

### 3.07 SPRINKLER HEADS

- A. Install sprinkler heads as recommended by manufacturer. Locate sprinkler heads as indicated on fire protection plan and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings, and walls. Install sprinkler heads level in locations not subject to spray pattern interference. When ducts, lights, or other objects are obstructions to sprinkler distribution, additional heads shall be provided beneath the obstruction.
- B. All sprinkler heads installed in finished ceilings shall be fed by a swing joint or return bend arrangement for final positioning in ceiling grid pattern during construction phases.
- C. All sprinkler heads shall be centered on ceiling tile.

### 3.08 GAUGES

- A. Provide a valved pressure gauge in main fire protection riser, at or near each test connection, and at the top of each piping riser. Provide gauge with a connection having a soft metal seated globe valve arranged for draining pipe between gauge and valve. Install gauges to permit removal and where they will not be subject to freezing.

### 3.09 VALVES

- A. Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing, and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.
- B. Install supervised-open gate valves located to control all sources of water supply except fire department connections. Each building shall have independent control valves for each sprinkler riser.

- C. Provide independent locked open control valves for shut-off of accidental sprinkler discharge in each room without removing the sprinkler protection in the remainder of the rooms.
- D. Provide permanently marked identification signs indicating the portion of the system controlled by each valve.
- E. Provide tamper switch on each shut-off valve.
- F. Install locking device with each shut-off valve to prevent inadvertent closing of the valve. Keys shall be indexed to identify valve location.

### 3.10 SPECIALTY VALVES

- A. Install in vertical position fire protection riser. Install trim recommended by manufacturer including drain and test valves. Pipe drains to hub or floor drains. Test and adjust operation of valves, alarms, pressure maintenance devices, and deluge/pre-action controls.

### 3.11 FIRE DEPARTMENT CONNECTIONS

- A. Fire department connections will be installed in the same location as the double check valve assembly. Mount on wall where indicated and/or as required. Support from structure independent of piping. Locate between 2 feet to 3 feet above grade. Fill wall penetration with insulation and caulk exterior and interior face of wall opening weathertight.
- B. Provide 1/2-inch automatic drip drain on inlet of fire department connection check valve and where indicated.

### 3.12 DOUBLE CHECK VALVE ASSEMBLY

- A. Double check valve assembly. Fire department connections shall be installed in one location to supply water to all sprinkler zones.

### 3.13 TEST CONNECTIONS

- A. Install test connections sized and located in accordance with NFPA Standards, complete with shut-off valve. Test connections may also serve as drain pipes.
- B. Provide test connections for each flow switch. Test connections shall discharge to appropriate receptacles. Outside discharge shall not be allowed.
- C. When test valves are located remote from the flow switch, the valve shall be identified with a brass tag denoting which flow switch is being tested.

### 3.14 FIRE ALARM SYSTEMS

- A. CONTRACTOR shall coordinate his work with the Fire Alarm System Contractor. The system (Fire Alarm and Fire Protection) must be compatible as listed in the Factory Mutual Research Approval Guide.

### 3.15 FINISHES

- A. See Section 09900 for methods and material required for work under this section.

### 3.16 TESTING

- A. Flush, test, and inspect sprinkler piping systems in accordance with NFPA 13.
- B. The sprinkler system shall be tested as an entire system or partial system. The system shall be hydrostatically tested at 200 psi for two hours. No leakage allowed. All defective joints shall be replaced with new materials. No caulking of defective joints shall be allowed. After defective joints are replaced, the system shall be retested until satisfactory results are obtained. Pipe shall not be concealed until satisfactorily pressure-tested.
- C. ENGINEER and OWNER shall be notified 24 hours prior to any pressure test. This test shall be performed in the presence of appropriate representatives for OWNER and ENGINEER. A log of tests shall be kept stating: who performed test, time and date of test, what section of system was tested, and results of test with properly executed Contractor's Material and Test Certification forms from NFPA 13, Chapter 8. This log shall be kept at the job site and submitted to ENGINEER for approval.
- D. Flow switches shall be operated to test that proper signals are transmitted to the Fire Alarm System.
- E. Include tests for tamper switches.

### 3.17 IDENTIFICATION

- A. Identify equipment with engraved nameplates.
- B. Identify interior piping mains not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Place flow directional arrows at each identification location. Provide one piece, preformed construction, snap-around pipe markers fastened by nylon ties at each end of the marker.
- C. Identify valves with signs per NFPA rulings.
- D. Provide a hydraulic design information sign of permanently marked weather proof metal or engraved nameplate material. Secure to alarm valve with brass chain or nylon wire ties. Information to include location of the design areas. Discharge densities, required flow and residual pressure at base of the riser, hose stream demand and fire sprinkler head demand.

END OF SECTION

## SECTION 15400

### PLUMBING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All material and piping for plumbing.
  - 2. Concrete foundations and anchor bolts for all equipment furnished under this section.
  - 3. Piping connections to all plumbing equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 1 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 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. All materials shall be National Sanitation Foundation (NSF)-approved.

##### 2.02 PLUMBING PIPING AND APPURTENANCES

- A. Unless otherwise specified, piping shall be in accordance with Section 15040–Piping and Accessories.

##### 2.03 PIPING SPECIALTIES

- A. Chemical Drain Line Plugs: On all floor drains immediately serving wash/soak sink, a drain plug shall be provided. Drain plug shall be plastic gripper plug manufactured by Cherne Industries, or equal. Drain plug shall consist of a rubber o-ring, plastic plate, and a twist to seal wing nut. All drain plugs shall be compatible with chemicals listed above and shall fit in floor drain indicated on the drawing and described in the specifications.
- B. Thermometers:
  - 1. Ashcroft, Marsh, Taylor, H. O. Trerice, U. S. Gauge, Weiss, Weksler.
  - 2. Stem Type: Cast aluminum case, 9-inch scale, clear acrylic window. adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:
    - a. Service: Hot Water.
    - b. Scale Range, °F: 30–180.
    - c. Increment, °F: 2.

- C. Thermometer Sockets: Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.

## 2.04 PLUMBING SPECIALTIES

- A. Unless otherwise specified, valves shall be provided in accordance with Section 15040-Piping and Accessories.
- B. Floor Drains:
  - 1. All floor drains shall be furnished and installed with all options and accessories required for a leak free installation within the particular construction in which they are to be mounted.
  - 2. Each floor drain shall be provided with a deep-seal P-trap unless otherwise noted.
  - 3. (FD-2) Floor drains for piping 4 inches and under shall be Zurn ZN-550, Wade W-1300, or equal, and for piping larger than 4 inches Zurn ZN-505, Wade W-1240, or equal. Drains receiving pump drainage piping shall be provided with Zurn Z-329, Wade EG-8, funnel converter assembly, or equal, finish to match floor drain finish. Provide nickel bronze grate.
  - 4. Each drain shall be provided with a trap. A minimum of one cleanout and one backwater valve with floor cleanout, Zurn Z-1095, or equal, shall be provided for each single or common leader.
- C. Trench Drains: (TD-1):
  - 1. Trench drains shall be ACO Drain KS100S by ACO Polymer Products, Poly Drain System by ABT, Inc., or equal.
  - 2. Trench drain channels shall be made of precast polymer concrete. Channels shall have top width of 8 inches, radiused bottom, minimum width of 4 inches, and nominal lengths of 1/2 meter or 1 meter. All channels shall interlock with tongue and groove connections with adjoining channels. Each channel shall have full length horizontal anchoring ribs. Channels shall have built-in bottom slope of 0.6%.
  - 3. Channel grates shall be made of stainless steel and have a slotted configuration. Grates shall be securely locked down to channel.
- D. Cleanouts:
  - 1. Manufacturers shall be Zurn, Wade, Smith, Josam, or equal.
  - 2. Each cleanout shall be gas and watertight.
  - 3. Cleanouts that are elevated shall include a membrane flashing flange to prevent leakage to the lower floor.
  - 4. Interior Concrete Floor Areas: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
  - 5. Interior Exposed Vertical Stacks: Line-type cleanout tee with tapered threaded ABS closure plug. Zurn Z-1445.
  - 6. Interior Horizontal Lines: Cast iron hub with tapped ferrule and tapered threaded ABS or PVC closure plug or no-hub coupling and blind plug.
  - 7. Exterior Paved Areas: Cast iron hub or plug with tapered threaded ABS or PVC closure plug, cast iron frost sleeve and cover set in 24-inch square by minimum 4-inch-thick reinforced concrete pad top or surrounding pavement, crowned for drainage. Neenah R-1976 with nonferrous securing screw.
  - 8. Exterior Unpaved Areas: Cast iron hub or plug with tapered threaded ABS or PVC closure plug, cast iron or PVC frost sleeve and cover set in 24-inch square by

minimum 4-inch-thick reinforced concrete pad top. Neenah R-1976 with nonferrous securing screw.

- E. Roof Drains:
  - 1. Roof drains shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are mounted.
  - 2. Roof drains shall be Zurn ZC-100, Wade W-3000, Smith 1010, Josam, or equal, with flashing clamp ring and gravel stop. All components shall be made of cast iron.
- F. Interior Hose Connection Vacuum Breakers: ASSE 1011, brass or bronze construction, EPDM diaphragm and seat, rated for 125 psig and 180°F. Hose connection vacuum breaker shall be Watts 8, or equal.
- G. Downspout Nozzle: Nozzle shall be Zurn, Jay R. Smith, or equal. Provide all nickel bronze body with decorative face of wall flange and outlet nozzle.
- H. Mixing Unit Hose Stations: Provide two mixing unit hose stations where indicated on the drawings. Mixing unit hose stations shall be Strahman Model M-1159 TG mixing units with ball valves. Provide Strahman Model M-70 series low flow water save spray nozzles (black) for each unit. Provide one 25 foot and one 50 foot hose. Hoses shall be black with type "B" use rating code. Provide one Watts Series LF008PCT anti-siphon spill resistant backflow preventer on each vertical drop to the Strahman mixing units.

## 2.05 PLUMBING FIXTURES

- A. All exposed metal fixture parts, piping, and valves are to be chromium plated.
- B. The following fixtures shall be Kohler (K), American Standard (A), or equal.
- C. Water Closet (WC): (WC-1) K-4302 High Crest, A-2305.100, floor mount, vitreous china, 1.6 gpf, ADA-compliant, 1 1/2-inch top spud, and elongated bowl. Provide white open front seat and Sloan Royal Model 111 Sloan Uppercut Model WES-111 flush valve.
- D. Lavatories: (L-1): K-2030 (20x18), A 0356.015, wall hung with pop-up drain, supplies and cast iron hanger in men's and women's rooms. Provide ADA-approved faucets.
  - 1. Provide ADA-approved paddle-handled faucet; Chicago Faucet 404-317SWCP with 327-ACP nonremovable strainer, or equal.
  - 2. Provide insulation wrap on hot water line and drain line as required by ADA. Faucet shall be NSF61-certified.
- E. Emergency Fixtures:
  - 1. Manufacturers: Bradley (B), Guardian (G), Haws (H), or equal.
  - 2. Unit shall be hydrostatically tested to meet or exceed ANSI Z358.1-1998.
  - 3. (EEWS-2): Corrosion-resistant safety station with ABS plastic shower head, ABS plastic bowl, cast aluminum powder-coated flag handle, PVC floor flange, 2-inch IPS Schedule 80 PVC pipe and fittings, 1-inch IPS and 1/2-inch IPS U.S.-made PVC-coated brass stay-open ball valve, and polished stainless steel pull rod. Unit shall have two polypropylene "GS" spray heads with integral "flip-top" dust covers, strainer, and 1.8 gpm flow control orifice mounted on chrome stainless steel head assembly. Model No. (B) S19-310PVC, (G) G1992, or (H) 8336.

4. (TMV-1): Thermostatic mixing valve with temperature override protection set for 85° valve for emergency shower. Unit shall include: built-in cold water bypass, thermostatic control valve, rough bronze finish, solid bimetal thermostat, limit stop factory set for 90°, integral check stops, dial thermometer, and recessed stainless steel cabinet with door and lock. Performance: Unit shall have a flow range of 3 gpm to 44 gpm with a maximum pressure loss of 20 psi and come with a full 1-year warranty. Model No. (G) G3800, or equal.

## 2.06 PLUMBING EQUIPMENT

- A. Commercial Electric Water Heater (WH-15-01):
  1. Manufacturers: A.O. Smith, or equal.
  2. Type: UL listed electric storage domestic water heater, model Dura-Power DEN-120.
  3. Performance:
    - a. Storage: 119-gallon minimum.
    - b. Input: 9.0 kW, 780 Volt, three phase, 60 Hz.
    - c. Minimum 60°F Recovery Rate: 41 gph.
    - d. Maximum Working Pressure: 150 psig.
  4. Tank: Steel glass-lined tank complete with removable magnesium anode rod, plastic diffuser-type dip tube, inlet and outlet heat trap fittings, minimum R-20 polyurethane foam insulation, painted steel jacket, drain valve, and temperature and pressure relief valve.
  5. Elements: Dual 4500 watt heating elements to be replaceable, threaded low watt density incoloy sheath with adjustable thermostat control, energy cutoff, and wired for simultaneous operation.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Unless otherwise specified, installation of piping shall be in accordance with Section 15040–Piping and Accessories.
- B. Plumbing system shall be installed with hangers and supports in accordance with the Wisconsin Plumbing Code. Insulation saddles 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 Building 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 9 and SPS 382.
- 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. Set commercial water heaters, commercial water softeners, storage tanks, and booster pumps on concrete housekeeping pads. Adjust and level equipment.
- H. Pipe temperature and pressure relief valves to floor drain or floor as indicated.
- I. Start-up and test equipment adjusting operating and safety controls for proper operation.
- J. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07900, color to match fixture. CONTRACTOR shall coordinate fixture hanger support with wall construction details.
- K. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- L. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy-duty-type with brass stems and screwed or sweat inlet connections. Compression-type inlets are not acceptable.
- M. Each piece of trim shall be furnished whether specifically mentioned or not, in order to provide a complete first-class installation. Furnish and install all required water, waste, soil and vent connections to all plumbing fixtures, together with all fittings, supports, fastening devices, cocks, valves, traps, etc. leaving all in complete working order.
- N. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- O. Provide isolation valves at plumbing equipment.

### 3.02 FIELD QUALITY CONTROL

- A. Unless otherwise specified, testing shall be in accordance with Section 15040–Piping and Accessories.
- B. Building drainage systems shall be tested and inspected in accordance with local requirements and the Wisconsin Building Code.

END OF SECTION

## SECTION 15420

### NATURAL GAS SERVICE SYSTEM

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Utility company.
  - 2. Primary service characteristics.
  - 3. Secondary service characteristics.
  - 4. Sequencing and scheduling.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 UTILITY COMPANY

- A. The Utility Company is Madison Gas and Electric.

##### 1.03 PRIMARY SERVICE CHARACTERISTICS

- A. The primary service from the natural gas main located north of the building will be 2 psig.

##### 1.04 SEQUENCING AND SCHEDULING

- A. Provide natural gas service system, except the Utility Company will provide:
  - 1. Piping from natural gas main to gas meter.
  - 2. Gas pressure regulator.
  - 3. Meter.
- B. Natural gas service will be relocated at no cost to OWNER.

#### PART 2–PRODUCTS

NOT APPLICABLE

#### PART 3–EXECUTION

##### 3.01 INSTALLATION

- A. Trench and backfill for gas lines in accordance with Division 2–Site Work.
- B. Install gas lines a minimum of 2 feet below finish grade.

END OF SECTION

## SECTION 15510

### HYDRONIC PIPING AND SPECIALTIES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Hydronic piping.
  - 2. Valves.
  - 3. Thermometers and gauges.
  - 4. Strainers.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A47-90-Specification for Ferritic Malleable Iron Castings.
- B. ASTM A53-90b-Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- C. ASTM A183-83 (1990)-Specification for Carbon Steel Track Bolts and Nuts.
- D. ASTM A234/A234M-92a-Specification for Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- E. ASTM D2000-90-Classification System for Rubber Products in Automotive Applications.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300-Submittals.

#### PART 2–PRODUCTS

##### 2.01 HYDRONIC PIPING (COOLING WATER)

- A. Hydronic piping 2 inches in diameter and less and drain and air vent piping shall be Type L hard copper piping with wrought copper sweat fittings with 50/50 solder joints. Piping shall conform to ASTM AB88 and fittings shall conform to ASTM B88, Class 125.
- B. Pro-Press fittings shall be an acceptable alternative to sweat fittings on piping 2 inches and smaller.

##### 2.02 VALVES

- A. Acceptable valve manufacturers are DeZurik, Apollo, Bell and Gossett, or equal.

- B. Balancing Valves:
  - 1. Balancing valves 2 inches and smaller shall be Bell and Gossett Model CB, or equal, with bronze body, brass ball orifice with O-ring stem seal, and glass- and carbon-filled seat rings. Ball orifice shall be bidirectional calibrated and provide positive shutoff. Valve shall have a position indicator with memory stop, pressure taps, and a drain tap. Valve shall be rated for 300 psi at 250°F.
  - 2. Provide Bell and Gossett Model RO-2, or equal, portable balancing read out meter for differential pressure measurement.
- C. Ball Valves:
  - 1. Shutoff valves 2 inches and smaller shall be Nibco S-585, or equal, ball valves with two-piece bronze body, 316 stainless steel ball and stem, and TFE seat. Valve shall be rated for 600 psig WOG.
  - 2. Provide stem extensions where necessary for access.
  - 3. Provide a lever operator for each valve.
- D. Relief Valve:
  - 1. Relief valves shall be as manufactured by Bell and Gossett, or equal, of bronze construction designed to ASME 125 psig standards.
  - 2. Valve shall be sized for 30 psig relief pressure and gross equipment outlet capacity.
- E. Drain Valves and Gauge Valves:
  - 1. Provide valve with threaded or sweat ends rated for 125 psig at 200°F. Valve shall have bronze body and Teflon seat.
  - 2. Drain valves shall be full size of piping runouts.
- F. Two-Way Control Valves (2 Inches and Smaller):
  - 1. Where shown on drawings, provide Belimo B2 series characterized control valves, or equal for valves 2 inches or smaller. Valve bodies shall be forged brass with chrome plated brass ball and stem or stainless steel with stainless steel ball and stem with Tefzel disc and PTFE seats.
  - 2. Valves shall have on-off modulating electric actuators supplied by the manufacturer. Actuators shall be Belimo, 24V type TR24 US or LR24 US series and capable of 200 psi close-off pressure. Control of valves shall be as described in Section 16940-Controls and Instrumentation. Operators shall modulate the disc through the full range of motion. Valves located in NEMA 4X areas shall be suitable for corrosive environments. Valves shall be powered on/spring closed.

## 2.03 THERMOMETERS AND GAUGES

- A. Acceptable manufacturers are Terice, or equal. All gauges and thermometers shall be mounted so that they can be read from the floor.
- B. Thermometers:
  - 1. Thermometers shall have chrome-plated brass fittings, adjustable 9-inch cast aluminum case, and glass-enclosed spirit-filled column.
  - 2. Temperature range shall be from 30°F to 240°.
  - 3. Furnish and install where shown on drawings.
  - 4. Furnish and install a brass well with a length suitable to extend past pipe insulation.

## 2.04 STRAINERS

- A. Provide cast iron "Y"-type strainers with a 304 stainless steel strainer, 1/8-inch perforations, dirt leg, blow-off valve, and 125 psig rating. Strainer sizes and locations shall be as shown on the drawings.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install all hydronic piping and specialties in accordance with manufacturer's recommendations and Section 15040-Piping and Accessories in locations as shown on drawings.
- B. Piping shall be run level and free of depressions or pockets. High points shall have manual air vents, and low points shall have drain plugs.
- C. Valves and strainers serving pumps shall be line size.
- D. Piping passing through exterior walls and roof shall be weatherproofed with flashing and silicone sealant watertight.
- E. Provide unions in supply and return connections to all equipment. Piping shall be arranged so that coils and equipment may be removed without dismantling piping beyond unions. Provide double swing joints at equipment connections.
- F. Connect piping to equipment served without strain as shown on the drawings. Install pipe loops in piping to allow for expansion and contraction.
- G. In joining two dissimilar types of pipe, standard fittings shall be used when available. The method of joining shall be submitted by CONTRACTOR to ENGINEER for approval prior to installation.

END OF SECTION

SECTION 15625  
FUEL-FIRED UNIT HEATERS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Gas-fired unit heaters (GUH).
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASHRAE 103–Heating Seasonal Efficiency of Central Furnaces and Boilers, Methods of Testing.
- B. NFPA 54 (AGA Z223.1)–National Fuel Gas Code.
- C. NFPA 70–National Electrical Code.
- D. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.
- E. NFPA 90B–Installation of Warm Air Heating and Air Conditioning Systems.
- F. NFPA 211–Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals. Included in submittals shall be detailed control wiring diagrams that show logic circuits for the unit as well as all external connections (i.e., dampers, SCADA, etc.).

1.04 QUALITY ASSURANCE

- A. All gas-fired heating equipment shall be design certified by the American Gas Association.
- B. All control panels shall be UL listed.

PART 2–PRODUCTS

2.01 GAS-FIRED UNIT HEATERS (GUH)

- A. Acceptable manufacturers are Modine, Trane, or Reznor.
- B. The unit cabinet shall be constructed of 20 gauge galvanized steel with a baked enamel finish.
- C. The unit fan shall have a propeller fan with a direct drive motor and fan guard.

- D. The unit heat exchanger shall be an indirect-fired, power-vented heat exchanger constructed of 409 stainless steel.
- E. Unit shall have an indirect-fired burner with power venting constructed of 409 stainless steel. Burner shall be furnished with a solid-state intermittent spark electronic ignition system with electronic flame supervision and stack damper. Unit heaters shall have an 80% thermal efficiency.
- F. Where schedules indicate, burner shall be serrated combustion, direct vent. Provide all combustion air and vent piping including concentric vent terminals in accordance with drawings and manufacturer's recommendations.
- G. Provide a gas train including 24 volt solenoid gas valve, main and pilot regulators, On-Off gas valve, transformer, high limit, stack damper, and fan On-Auto switch to operate fan without firing the burner.
- H. All burner and blower controls including motor starters shall be furnished by unit manufacturer and shall be factory-prewired. Equipment disconnect shall be provided by Division 16 contractor.
- I. Manufacturer shall furnish low voltage thermostat. Thermostat shall be Honeywell Model Number T8575D, or equal, with fan auto-on selector switch with room temperature setpoint adjustment. Control range shall be from 50°F to 90°F.
- J. Provide two-way adjustable air deflector louvers.
- K. Mount units to provide 8 feet 0 inches clearance below, unless otherwise shown on the drawings.
- L. Gas unit heaters (GUH) shall be controlled by a low voltage remote-mounted thermostat furnished by the manufacturer with a fan on when room temperature falls below thermostat setpoint. Provide wiring between thermostat and unit heater. Control power shall be from control power transformer at unit.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install equipment in accordance with NFPA 54 and NFPA 90A. Provide connection to gas system.
- B. Provide vent connections in accordance with NFPA 211. Provide combustion air intake and vents in accordance with drawings and manufacturer's recommendations.
- C. Drawings are based on the scheduled equipment make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.

- D. 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.
  
- E. Gas unit heaters (GUH) shall be controlled by a low voltage remote-mounted thermostat furnished by the manufacturer with a fan on when room temperature falls below thermostat setpoint. Provide wiring between thermostat and unit heater. Control power shall be from control power transformer at unit.

END OF SECTION

## SECTION 15820

### DEHUMIDIFICATION EQUIPMENT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: High-efficiency dehumidification equipment.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 HIGH-EFFICIENCY DEHUMIDIFICATION EQUIPMENT

- A. Provide dehumidification equipment which meets the requirement listed below and on equipment schedule. Acceptable manufacturer is Hi-E Dry, or equal. Equipment schedule is located on the drawings.
- B. Provide a high-efficiency dehumidifier that utilizes refrigeration to cool the incoming air stream below its dewpoint as it passes through the dehumidification (evaporator) coil. The cooled and dried air shall be used to pre-cool the incoming air stream to result in a 200% to 300 percent increase in overall efficiency.
- C. The unit shall be controlled by an integral dehumidistat with settings from 20% to 80% relative humidity and a positive “on” and “off” setting.
- D. The unit shall contain a blower switch that shall permit continuous blower operation independent of dehumidification.
- E. The unit shall be portable and provided with four casters.
- F. The unit shall contain an internal condensate pump capable of lifting condensate 12 feet, and 20 feet of condensate hose.
- G. The wiring of the unit shall be through a factory-installed 6-foot power cord; 115 volt with ground.

#### 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 15820-1

1020.066

## SECTION 15835

### TERMINAL HEAT TRANSFER UNITS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Electric Heaters.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. NFPA 70–National Electric Code.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.

#### 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. Electric Wall Heaters (EWH):
  1. Acceptable manufacturer is QMark, or equal.
  2. Furnish and install a steel cabinet for surfaced mounting.
  3. Provide a cabinet with 16 gauge steel grille bars and finished in a baked enamel.
  4. Provide a direct drive, propeller fan, and permanently lubricated totally enclosed motor.
  5. Provide steel finned metal sheath electric heating elements.
  6. Provide automatic reset thermal overheat protection to disconnect power in the event of overheating. Provide an integral, tamper-resistant thermostat. Provide integral contactors and disconnects.
  7. Controlled by an integral thermostat.

#### 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. Drawings are based on the scheduled make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.

END OF SECTION

## SECTION 15855

### AIR HANDLING UNITS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Fan coil units (FCU).
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ARI 430—Central Station Air Handling Units.
- B. ASHRAE 15—Safety Code for Mechanical Refrigeration.
- C. NFPA 70—National Electric Code.
- D. NFPA 90A—Standard for the Installation of Air Conditioning and Ventilating Systems.
- E. UL900—Test Performance of Air Filter Units.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300—Submittals. Included in submittals shall be detailed control wiring diagrams specific to the project that show logic circuits for the unit as well as all external connections (e.g. dampers, etc.).

##### 1.04 QUALITY ASSURANCE

- A. Unit performance shall be certified in accordance with ARI Standard 430 for Central Station Air Handling Units.
- B. Direct-expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration, latest edition.
- C. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.

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

- A. Unit shall be stored and handled in accordance with the unit manufacturer's instructions.

## PART 2-PRODUCTS

### 2.01 FAN COIL UNITS (FCU)

- A. Acceptable manufacturers are EnviroTec, McQuay, or equal.
- B. General:
1. Furnish and install Belt Drive Fan Coil Units where indicated on the plans and specifications. Units shall be completely factory assembled and tested and shipped as one piece.
  2. All units shall be capable of meeting or exceeding the scheduled capacities for cooling, heating and air delivery. All unit dimensions for each model and size shall be considered maximums.
  3. All units shall be of "draw-thru" design with coils, fans, motor/ drive and drain pan completely contained within the unit cabinet.
  4. Units shall be cETL listed in compliance with UL/ANSI Std. 1995.
  5. All unit coils shall meet or exceed the scheduled cooling and heating capacity, selected and rated in accordance with ARI 410.
- C. Construction:
1. All units shall be fabricated of minimum 18 gauge galvanized steel, able to withstand a 125 hour salt spray test per ASTM B-117. All exterior panels shall be single wall insulated with 1 inch thick fiberglass insulation, rated for a maximum air velocity of 5000 f.p.m. Adhesives shall comply with NFPA 90A. Adhesive as the only method of fastening the insulation to the casing is not acceptable. Maximum thermal conductivity shall be 0.24. Insulation must meet all requirements of UL 181 and NFPA 90A. All units shall have minimum 1" duct collars on discharge and return.
  2. All access panels shall be fully insulated and attached with standard fasteners on at least two opposite sides. No single access panel shall be larger than 30" x 36" for safety and ease of handling. No coil or drain piping or electrical connections shall pass through any access panel.
  3. Each unit shall be furnished with a one-piece heavy gauge G90 steel drain pan with welded corner construction. All units shall be provided with 9/16" diameter hanger rod holes in the top and bottom panels for "through-bolt" type suspension installation.
- D. Fan Assembly: All units shall be furnished with standard selection double inlet forward curved centrifugal blowers statically and dynamically balanced for smooth operation. All blower wheels shall have two set screws and shall be mounted on solid steel shafting rotating in ball bearings with a minimum design average life (L50) of 100,000 hours. All standard blower assemblies shall have resilient mounted cartridge type permanently lubricated ball bearings.
- E. Fan Motor and Drive Assembly:
1. All fan motors shall be standard NEMA design motors of the horsepower listed in the equipment schedule. All motors shall be 1750 RPM, 60 hertz ODP single speed motors rated for continuous duty. All motors shall be reversible rotation type.
  2. Three phase motors shall be "across-the-line" start type.
  3. All motors shall be mounted on an adjustable base.
  4. All motor wiring is to be terminated in a junction box, external to the unit casing.
  5. All fan drive assemblies shall include an adjustable pitch motor pulley, a fixed pitch blower pulley and a standard cross section "V-belt". All fan drives shall be selected at a minimum service factor of 1.2.

- F. Coils:
  - 1. All unit coils shall be rated in accordance with ARI 410.
  - 2. All coils shall be 1/2" O.D. seamless copper tubes with collared aluminum fins. All tubes shall be mechanically expanded to provide an efficient bond between tube and fin. All water coils shall be provided with a manual air vent fitting to allow for coil venting. Valve core type vent fittings shall not be accepted.
  - 3. All chilled water coils shall have aluminum fins and 0.016" tube wall thickness.
  - 4. All coils shall be hydrostatically tested with air under water at 450 PSIG minimum pressure and rated for a maximum of 300 PSIG working pressure at 200°F.
  
- G. Filter Rack Assembly: All units shall be furnished with a flat filter rack with hinged access on both sides designed to accept a 2" nominal standard sized filters. All units shall be provided with nominal 2" throwaway filters factory installed.
  
- H. Electrical Control: The unit fan motor shall be completely factory wired to an external electrical enclosure. Each unit shall include fan control package with 24 volt control voltage. Each unit shall include motor circuit fusing, starter, control circuit transformer and terminal strip for connection of field wiring.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install in accordance with drawings and manufacturer's recommendations.
  
- B. Pipe and trap condensate to nearest floor drain in accordance with Section 15400-Plumbing.
  
- C. Furnish and install neoprene vibration isolators sized by the manufacturer.
  
- 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 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.
  
- E. Provide flexible duct connections on outlet of unit in accordance with Section 15910-Ductwork Accessories.
  
- F. 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.
  
- G. All duct work routed on the exterior of a building shall be insulated in accordance with Section 15290-Heating, Ventilation, and Air Conditioning Insulation.

- H. Provide refrigerant line insulation in accordance with Section 15290–Heating, Ventilation, and Air Conditioning Insulation.
- I. Provide lubrication line extenders as required to allow regreasing of bearings without removal of equipment components.

3.02 CLEANING

- A. Unit shall be cleaned and new filters shall be furnished and installed prior to final acceptance by OWNER.

END OF SECTION

SECTION 15860  
CENTRIFUGAL FANS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Vertical upblast fans.
  - 2. Centrifugal inline fans.
  - 3. Ceiling or cabinet fans.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. AMCA 99–Standards Handbook.
- B. AMCA 210–Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300–Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301–Method of Calculating Fan Sound Ratings from Laboratory Test Data.
- E. NFPA 70–National Electrical Code.
- F. NEMA MG I–Motors and Generators.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.

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.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers are Greenheck, Cook, or equal.

- 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. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

## 2.02 VERTICAL UPBLAST FANS

- A. Vertical upblast fans shall be of drive type listed on drawing schedules. Fan installation shall include roof curb, motorized control dampers, drain trough, and bird guard. Fan performance shall be as indicated on drawings schedules. Fans shall be UL listed. Dampers shall meet requirements of Section 15910—Temperature Controls and Instrumentation.
- B. The fan housing shall be aluminum with all fasteners either aluminum or stainless steel.
- C. All fan wheels shall have backward-inclined or forward-curved blades, and the fan wheel shall be statically and dynamically balanced.
- D. The entire drive assembly shall be mounted on neoprene vibration isolators to provide quiet, vibration free operation. Fan performance shall include AMCA-certified air and sound ratings, and fans shall bear the AMCA seal.
- E. The fan motor shall be totally enclosed, fan-cooled, and shall be NEMA approved.
- F. 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.
- G. The fan shaft shall be mounted in prelubricated sealed ball bearing pillow blocks. Bearings shall have a minimum  $L_{50}$  life of 500,000 hours. Belt drives shall have an adjustable motor plate for belt tensioning. Belt driven motors and drives shall be mounted out of the airstream.
- H. Provide an aluminum wire bird guard on the fan's discharge.
- I. Manufacturer shall provide a prefabricated, insulated roof curb with wood blocking to level curb on roof. The roof curb insulation shall be 1 1/2 inches thick, 3 pounds per cubic foot rigid fiberglass board. Curb height shall be nominal 12 inches unless otherwise indicated. Fans on pitched roof shall be provided with pitched and crickets roof curb.
- J. Where drawings indicate fan to be suitable for corrosive environments, all surfaces of fans, screens, dampers, and liners 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.
- K. Provide baked enamel finish. Color to be selected by OWNER. Submit color chart with shop drawings.

## 2.03 CENTRIFUGAL INLINE FANS

- A. 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.
- B. The fan wheel shall be centrifugal with backward-inclined blades. The fan wheel shall be statically and dynamically balanced.
- C. 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.
- D. The fan shaft shall be mounted in prelubricated ball bearing pillow blocks. Bearings shall be sealed and have a minimum L<sub>50</sub> life of 500,000 hours.
- E. The fan housing shall be all aluminum construction with square inlet and discharge collars. Provide access panels for servicing drives and motors.
- F. 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 shall be NEMA approved, ball bearing-type. Starters and disconnects shall be provided as a part of Division 16.
- G. 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.
- H. 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.

## 2.04 CEILING FANS OR CABINET FANS

- A. Fans shall have acoustically insulated housings and shall have maximum sound level rating not to exceed 4.0 sones in accordance with AMCA Bulletin 300-74. Fans shall bear the AMCA-certified ratings and seal for air capacity, sound, and UL label.
- B. Unit shall be equipped with integral chatter-proof backdraft damper.
- C. Fans shall have centrifugal wheel with inlet perpendicular to grille. Ceiling grille shall be aero-dynamically designed and shall provide 80% free area.
- D. Terminal box shall be furnished with cord, plug, and receptacle inside housing. Entire fan, motor, and wheel assembly shall be removable without disturbing the housing. Motor speed shall not exceed 1,100 rpm.
- E. Fan shall be mounted on vibration isolators furnished by fan manufacturer.

- F. Manufacturer shall furnish line voltage variable speed controller for fan. Controller shall be used for balancing only and shall be inaccessible to room occupants unless otherwise indicated on the drawings.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and drawings.
- B. CONTRACTOR to provide all mounting hardware and accessories necessary to complete installation.
- C. Provide flexible duct connections on inlet and outlet of all fans.
- D. Drawings are based on the scheduled fan make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.

END OF SECTION

## SECTION 15890

### DUCTWORK

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Metal ductwork.
  - 2. Nonmetal ductwork.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A36–Structural Steel.
- B. ASTM A90–Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- C. ASTM A167–Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A480–General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- E. ASTM A653–Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- F. ASTM A527–Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- G. NBS PS 15–Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.
- H. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.
- I. NFPA 90B–Installation of Warm Air Heating and Air Conditioning Systems.
- J. SMACNA–HVAC Air Duct Leakage Test Manual.
- K. SMACNA–HVAC Duct Construction Standards–Metal and Flexible.
- L. UL 181–Factory-Made Air Ducts and Connectors.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–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 01700–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.

### PART 2–PRODUCTS

#### 2.01 MATERIALS

- A. All sheet metal used for construction of duct shall be 24 gauge or heavier.
- B. Galvanized steel ducts shall be ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating in conformance with ASTM A90, A653.
- C. Aluminum ducts shall be ASTM B209; Type 3003-H14 aluminum.
- D. Stainless Steel Ducts: ASTM A240/A240M and A480/A480M, Type 304 or 316 as indicated on drawings.
- E. PVC Ducts:
  - 1. PVC material shall conform to ASTM D1784, Class 12454-B. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact pipe conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467, and for threaded, ASTM D2464.
  - 2. All duct delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent weld, except where flanges are required or as shown on the drawings or where transition to another pipe material is required.
  - 3. All exterior exposed duct shall be formulated with sufficient ultraviolet-light screeners to provide for long-term outdoor exposure with no deleterious effects.
  - 4. Entire duct shall be of PVC construction. PVC-coated materials are not acceptable.

- F. Glass Fiber Reinforced Plastic (FRP) Ducts:
  - 1. Fiber reinforced plastic ducts shall be as manufactured by Spunstrand, Composite Systems, or equal. Ductwork shall be glass fiber reinforced plastic to SMACNA Standards, with minimum 3/16-inch wall thickness.
  - 2. Where indicated on drawings to be of nonflammable construction, duct shall be built to NBS PS 15 standards with inner epoxy resin rich carbon surfacing veil and a 100 mil corrosion barrier. The balance of construction shall be filament wound with a 6-ounce cloth exterior.
- G. All fasteners shall be 316 stainless steel unless otherwise indicated.
- H. Duct sealant shall be United McGill United Duct Sealer, or equal, for indoor applications and United McGill Uni-Weather, or equal, for outdoor applications. Sealant shall be UL classified for flame and smoke development and shall be suitable for mating materials.
- I. 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.
- J. All ductwork in corrosive areas shall be stainless steel unless otherwise indicated.

## 2.02 DUCTWORK FABRICATION

- A. Field and Shop Fabricated Ductwork (Rectangular):
  - 1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible. Provide duct material, gages, reinforcing, and sealing in accordance with SMACNA Standards for 2-inch static rating, 2,500 fpm velocity, and duct seal Class A.
  - 2. Construct Ts, 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 15910–Ductwork Accessories.
  - 3. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
  - 4. Provide 45 degree expanded entry takeoffs unless otherwise indicated. Flange ductwork for attachment to grille registers and outlets unless otherwise detailed.

## 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. Exposed ductwork shall be painted per Division 9—Finishes.
- H. Connect air diffusers, registers, and grilles to supply and return ducts directly, unless flexible ductwork is specifically indicated on the drawings. Where registers and grilles are to be mounted on exposed ductwork, provide flanged opening for finished appearance.
- I. FRP and PVC ductwork shall have joints sealed per manufacturer's recommendations. Duct shall be supported so that no hanging equipment fasteners or accessories penetrate ductwork.
- J. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- K. Provide an experienced installer to go through the air distribution system with the balancer.
- L. Any modifications to the ductwork shown on the drawings must be approved by ENGINEER prior to installation. Any changes in the ductwork layout not approved by ENGINEER affecting static pressure shall be the responsibility of CONTRACTOR to modify air handling equipment at no additional cost to OWNER.
- M. Spray paint ductwork interior flat black at all diffuser and grille connections.

END OF SECTION

## SECTION 15910

### 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. Control dampers.
  - 6. Balancing dampers.
  - 7. Dampers and actuators.
  - 8. Side access filters.
  - 9. Duct silencer.
  
- B. Related Sections and Divisions: Applicable provisions of Division 1 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 01300—Submittals.

##### 1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700—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.

- B. Provide Chicago Plastics Systems PVC gasketed duct access doors with hinges and plastic knobs in all PVC ductwork, or equal.

## 2.02 DUCT TEST HOLES

- A. Provide Ventfabrics, Inc. No. 699 Instrument Test Holes, or equal, complete with gaskets and screw caps.

## 2.03 FLEXIBLE DUCT CONNECTIONS

- A. All ductwork shall be isolated from fans, fan enclosures, etc., with flexible connections. Provide connections to air handling equipment (except as noted), with Ventfabrics, Inc., "Ventglass," or equal, neoprene coated glass fabric with a metal-to-metal fabric length of approximately 6 inches.

## 2.04 DUCT SCREENS

- A. Provide screens equal to Ryerson Ryex Standard, 3/4-inch, 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.
- B. In PVC ductwork, provide screen equal to Harrison Machine and Plastic, 3/4 inch with border frame for protection, in lieu of metal. Install screen at sufficient angle to provide 60% of duct-free area through screen.

## 2.05 BALANCING DAMPERS

- A. Dampers for metal ductwork shall be single blade, manual balancing damper of same construction as specified for ductwork. Damper shall conform to SMACNA standards for single blade type volume dampers.
- B. Dampers for PVC ductwork shall be Chicago Plastics Systems Blastgate or quadrant damper, or equal. Dampers shall be PVC with locakable blades for balancing.
- C. Dampers for RFP ductwork shall be Spunstrand ZL, or equal. Dampers shall be of FRP construction and designed for balancing applications.

## 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. Dampers for corrosive environments shall be TAMCO Series 9000SW provided with an anodized coating and stainless steel linkage.
  - 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 4.0 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 nonCFC, 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.

B. Actuators:

1. Actuators shall be Belimo NFBUP, Honeywell MS4110, or equal, maintenance-free actuator rated for at minimum 88 inches/lb. of torque. Dampers shall be power-to-open, spring-closed unless otherwise specified. Provide auxiliary switch where noted on drawings. 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.

## 2.07 SIDE ACCESS FILTER HOUSING

- A. A single stage filtration system shall be provided for the blower inlet ductwork as indicated on the drawings and as specified below. The filter system shall include the following:
1. Filters
  2. Camfill Farr 3P Glide/Pack filter housing.
  3. Filter access door.
  4. Filter adapter.
  5. Filter housing support from ceiling.
- B. The filters shall be Camfil Hi-Cap type with a polyester type medium that meets the ASHRAE Standard 52.1-1992 Average Arrestance of greater than 80% but less than 90%, and an Average Dust Spot Efficiency of greater than or equal to 30%. See schedules for Minimum Efficiency Reporting Value, airflow capacity, and pressure drop requirements. Filters shall have a minimum efficiency reporting value of 7.
- C. Each filter system shall include the framework, housing, access door, and adapter that shall be of stainless steel construction. The access door shall be sealed to prevent air infiltration. The housing shall be of single wall construction.

## 2.08 DUCT SILENCERS

- A. Acceptable manufacturers are Vibro-Acoustics, or equal.
- B. Submittal Data:
1. Submit laboratory acoustic and aerodynamic performance obtained according to ASTM E477-06a and so certified when submitted for approval. The laboratory must be currently NVLAP accredited for the ASTM E477-06a test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted.
    - a. Submitted silencer pressure drops shall not exceed those listed in the silencer schedule.
    - b. The manufacturer shall supply certified dynamic insertion loss and self-noise power level data for each scheduled silencer. The data shall match the project's air

distribution system requirement for forward or reverse flow, and total system airflow.

- c. Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule.
- d. Silencer generated noise shall not be greater than that listed in the silencer schedule.

C. General Requirements:

- 1. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.
- 2. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings.
- 3. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Material gauges shall be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.
- 4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed except as noted below, to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
- 5. All perforated steel shall be adequately stiffened to insure flatness and form. All spot welds shall be painted.
- 6. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill, Vibar™ film liner, sealants, and acoustical spacer, shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
- 7. Retain subparagraph below to comply with LEED-NC Prerequisite EQ 1.
- 8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

D. Rectangular Elbow Silencers: Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, 18 gauge. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as necessary to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 48 inches shall have at least two half splitters and one full splitter.

E. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel, 22 gauge minimum.

F. Sound-Absorbing Mechanism: Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.

- G. Media Protection: Media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.
- H. HTL Casings: Silencers shall have high transmission loss (HTL) walls externally applied and completely sealed to the silencer casing by the silencer manufacturer to assure quality controlled transmission loss. The HTL walls shall consist of media, airspace, mass and outer protective metal skin, as required, to obtain the specified room noise criteria. Standard acoustical panels will not be accepted as HTL walls. Breakout noise calculations for each air handling and fan system shall be provided with the silencer submittal to insure compliance with the room noise criteria. Breakout noise calculations shall be based on the sound power levels of the specified equipment.

## 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 15890–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. Provide duct test holes as necessary for testing and balancing purposes.
- E. Provide fire dampers at locations indicated and where ducts and outlets pass through fire rated components. Install with perimeter mounting angles, sleeves, breakaway duct connections, corrosion-resistant springs, bearings, bushings, and hinges.
- F. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Metal-to-metal gap shall be approximately 4 inches.
- G. 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.
- H. Provide balancing dampers on duct take-off to diffusers, grilles, and registers regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- I. Install all dampers in accessible locations with ample space to install direct coupled actuator, housing, and accessories.

END OF SECTION

## SECTION 15940

### 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 1 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 01300–Submittals.

##### 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. RG-1: Return, exhaust, and transfer grilles for sidewall and surface mounting shall be Carnes model RSLA, or equal. Grilles shall be steel construction with 45° horizontal louvered blades.

- C. SG-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 ESK 402, or equal. See drawings for sizes and locations.
- B. Blades and frame shall be extruded aluminum 6063-T5 alloy and 0.08-inch thickness. Blades shall be 37 degrees drainable-type spaced at 4 inches on center. Louver shall be capable of a velocity of 689 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.
- C. Provide channel frame, unless noted otherwise on the drawings.
- D. 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.
- E. Louvers shall be furnished with 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, bird screen, and motorized damper.
- C. Manufacturer shall furnish and CONTRACTOR shall install a prefabricated, insulated roof curb with wood blocking to match roof pitch to allow for a level curb on roof. Curb insulation shall be 1 1/2 inches thick, 3 pounds per cubic foot rigid fiberglass board. Curb height for low side of curb shall be 12 inches unless otherwise indicated. Curb shall have an aluminum liner.
- D. Provide baked enamel finish. Color to be selected by OWNER. Submit manufacturer's standard color chart with shop drawings.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install diffusers, grilles, and registers in locations shown on 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 15990

### TESTING, ADJUSTING, AND BALANCING

#### PART 1—GENERAL

##### 1.01 GENERAL

- A. Work Included:
  - 1. Balancing air systems.
  - 2. Balancing water systems.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit under provisions of Section 01300—Submittals.
- B. Prior to final balancing, submit a final report which includes the following information.
  - 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 and pump:
    - a. Unit number.
    - b. Fan size and wheel type (Pump size and impeller).
    - c. Motor horsepower.
    - d. Motor nameplate voltage and amps.
    - e. Design CFM and static pressure (total pressure) (Pump GPM and head).
    - f. Actual CFM and static pressure (total pressure) (Pump GPM and head).
    - g. Actual fan RPM (Pump RPM).
    - h. Actual motor voltage and amps (each phase).
  - 3. For piping: For piping system, record water flow through all equipment and inlet and outlet water pressure at each pump together with motor nameplate and actual current.
- C. Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting, and balancing. Provide recommendations for correcting unsatisfactory performances, and indicate whether modifications required are within the scope of the contract, are design-related, or installation-related. List instrumentation used during testing, adjusting, and balancing procedures.

##### 1.03 QUALITY ASSURANCE

- A. Obtain services of an independent testing organization to perform testing and balancing work. The criteria for determining qualifications shall be membership in the Associated Air

Balance Council (AABC), or certification by the National Environmental Balancing Bureau (NEBB).

- B. Balancing procedures shall be observed by Division 15 contractor, temperature controls contractor, OWNER, or ENGINEER. Balancing report must include verification of observation by any of the parties listed above.

## 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 0-300°F range.
  6. Amprobe model RS-3, or equal.
  7. Calibrated pressure gauge (0-100 feet water head).
  8. Inclined manometer 0-30 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 REPORT

- A. Provide an experienced installer to check the air distribution system for completion to be sure that 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, 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.

### 3.02 ROOM AIR PRESSURE RELATIONSHIPS

- A. The balancing contractor shall pay special attention to specific room pressure relationships specified. Rooms indicated to be positive or negative shall be balanced such. Rooms indicated to be positive shall have 10% more supply air than return/exhaust air quantities. Rooms indicated to be negative shall have 10% more exhaust than supply air quantities.

The balancing contractor shall adjust and change fan drives to provide this feature regardless of plan air quantities noted on drawings.

### 3.03 METHOD OF AIR BALANCE (CONSTANT VOLUME SYSTEMS)

- A. Prepare balancing sheets tabulating air quantities, unit areas, correction factors, and calculated air velocities required for each terminal system. For procedures not specified, follow AABC. Balancing shall be completed with all doors closed.
- B. Adjust total air quantity to 110% of design, as measured by duct traverse, by adjusting fan speeds or branch duct volume dampers.
- C. Read and record on the balance sheets the air velocities and volumes obtained. (Do not change any volume dampers while reading and recording.)
- D. If air quantities are not within 10% of design values, readjust the duct terminal dampers to proportion the air.
- E. Adjust the fan speed or the branch duct damper to adjust the air volume and then reread and record.
- F. Immediately after completion of the final round, measure the total pressure in the duct and record on the balance sheet.
- G. Adjust register, dampers, etc., to equalize the air volume between outlets and adjust air pattern on supply outlets to produce the correct air pattern.
- H. Repeat the above for each branch duct system.
- I. Proportion the air flow for each branch duct system by adjusting the branch duct volume dampers using a pitot tube traverse or the total pressure reading recorded above.
- J. Adjust the fan speed to deliver or exhaust the required air volume when the automatic dampers are placed in the 100% outside air position (and 100% exhaust air position when so equipped). Balance modulating dampers at extreme conditions, and record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, minimum flow rate, and full heating; record all data.
- K. Measure static pressure ahead of filters and heating coil. Measure static pressure at fan inlets and fan outlets. Correct any problems. Measure fan speed and motor inputs and compare with manufacturer's fan data to determine the point of operation. Adjust fan speeds to produce the correct air volumes. (Do not overload the motors.) Reread and record the pressure (positive and negative), RPM, and motor input readings.
- L. Final air volumes shall be within 10% of design values except that specified room air pressure relationships must be provided. Provide reports on pressure relationships.

### 3.04 METHOD OF WATER BALANCE

- A. The balancer shall provide a mechanic to check the water distribution systems for completion, properly installed control valves, and flow measuring devices. The mechanic

shall also assist the balancing contractor in locating all control and flow measuring devices and remove any piping restrictions found by the balancing contractor.

- B. The balancer shall report any discrepancies or omissions immediately.
- C. Adjust the water flow through equipment not having automatic control valves by use of Ultrasonic Dopler Meter or flow reading balancing valves. Set all balancing valves, and permanently mark position on valves.
- D. All automatic control valves shall be opened wide to the coils.
- E. Check the water flow by measuring the pump pressures and motor input, and compare to the pump manufacturer's performance curves.
- F. For equipment specified with balancing valves or flow meters, measure flow and pressure drops. Set all balancing valves, and permanently mark position on valves.
- G. Proportion the water flow to all equipment.
- H. Record the water flow through all coils and equipment. Flows through 3-way bypass valves shall be adjusted to balance through the coil and in bypass position.
- I. Read and record inlet and outlet water pressures at each pump together with motor rating, correct input, and flow measuring station.
- J. Final water flows shall be within 10% of design values for heating flow rates and 5% for cooling flow rates.

### 3.05 THERMAL PERFORMANCE TESTING

- A. Measure and record system measurements for each system described below. Measurements shall be taken with coils at 100 percent capacity. Contractor shall make provisions for seasonal testing.
- B. Chilled Water Coils:
  - 1. Coil location.
  - 2. Design and actual water flows.
  - 3. Actual airflow during testing.
  - 4. Design and actual entering air temperature (dry bulb and wet bulb)
  - 5. Design and actual leaving air temperature (dry bulb and wet bulb)
  - 6. Actual pressure drop across the coil (both water and air).
  - 7. Design and actual entering water temperature.
  - 8. Design and actual leaving water temperature.
  - 9. Designation of wet or dry coil.
- C. Hot Water Coils:
  - 1. Coil location.
  - 2. Design and actual water flows.
  - 3. Actual airflow during testing.
  - 4. Design and actual entering air temperature (dry bulb)
  - 5. Design and actual leaving air temperature (dry bulb)
  - 6. Actual pressure drop across the coil (both water and air).

7. Design and actual entering water temperature.
  8. Design and actual leaving water temperature.
- D. Direct Expansion Coils:
1. Coil location.
  2. Design and actual water flows.
  3. Actual airflow during testing.
  4. Design and actual entering air temperature (dry bulb and wet bulb)
  5. Design and actual leaving air temperature (dry bulb and wet bulb)
  6. Actual pressure drop across the coil.
  7. Refrigerant saturated suction temperature.
  8. Designation of wet or dry coil.
- E. Natural Gas Burners In Makeup Air Units And Gas Duct Furnaces:
1. Coil location.
  2. Actual airflow during testing.
  3. Design and actual entering air temperature (dry bulb)
  4. Design and actual leaving air temperature (dry bulb)
  5. Actual pressure drop across the coil.
- F. Electric Heating Coils:
1. Coil location.
  2. Actual airflow during testing.
  3. Design and actual entering air temperature (dry bulb)
  4. Design and actual leaving air temperature (dry bulb)
  5. Actual pressure drop across the coil.
  6. Actual voltage and amperage (each phase).

### 3.06 GENERAL REQUIREMENTS

- A. Contact the temperature control contractor for assistance in operation and adjustment of controls during testing, adjusting, and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.
- B. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- C. Division 15 Contractor to 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. Test and balance agency will notify the project representative of these items and instructions will be issued to the Division 15 Contractor for correction of the deficient work.

END OF SECTION

## SECTION 16010

### 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 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/NFPA 70–National Electrical Code.
- B. ANSI/IEEE C2.

##### 1.03 CONTRACT DOCUMENTS

- A. Any device or fixture 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.

##### 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, 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 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, manhole 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. 480 volt, 3 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 16.
  - 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. CONTRACTOR shall connect the following equipment furnished by Divisions 11 and 15 consisting of components indicated on the drawings or specified herein, including but not limited to:
  - 1. Unit heater fans.
  - 2. HVAC unit starters.
  - 3. Pumps, starters and control panels.
  - 4. Air intake and exhaust fans.
- C. Provide balancing and adjusting of electrical loads.
- D. 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.
- E. Provide miscellaneous items for a complete and functioning system as indicated on the drawings and specified herein.
- F. A partial list of work not included in Division 16 is as follows: Painting (except as otherwise specified herein).

## 1.08 NOISE

- A. Eliminate any abnormal noises which 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 light fixtures, confer with ENGINEER as to desired location in the various areas. In no case should fixture locations be determined by scaling drawings. Relocate fixtures 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 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 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 01300–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 16480–Motor Control and Section 16940–Controls and Instrumentation.

- C. These drawings and diagrams shall show all 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 fixtures, 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 1—General Requirements.

## PART 2—PRODUCTS

### 2.01 STANDARD PRODUCTS

- A. All equipment shall be UL and NEMA approved.
- B. Unless specified otherwise, major distribution equipment such as panelboards, motor control centers, motor starters, SPD, transformers, etc., shall each be by the same manufacturer.
- C. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, rain-tight, dust-tight, 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 16420-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 building 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 their 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 CLEANING UP AND REMOVAL OF RUBBISH

- A. All lighting and appliance panelboards, MCCs, motor starter and disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cutoff prior to installation of covers.
- B. Where louvers are provided in MCCs, or transformer enclosures, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in equipment such as control panels, motor control centers and transformers, CONTRACTOR shall replace all filters with new at the time of final completion.
- C. All lighting fixture lenses and lamps (interior and exterior fixtures) shall be cleaned at time of installation, and all lens exteriors shall be cleaned just prior to final inspection.
- D. 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 MCCs, etc. Pads shall be 3 inches larger than equipment being supported.
- B. Concrete shall comply with Section 03300–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 which will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.
- D. Caulking shall be performed by craftsman skilled at such work.

### 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. Where starters or other devices are provided by others, they shall be connected and wired by CONTRACTOR.
- D. 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.
- E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters as specified here or under the various trades' sections of these specifications.
- F. 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 herein specified and as shown on the drawings. Low voltage control wiring (below 100 volts) shall be provided by CONTRACTOR supplying the equipment which has low voltage wiring unless otherwise noted. CONTRACTOR shall provide raceways for ALL low voltage wiring.
- G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.
- H. 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 volt, 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 02222–Excavation, Fill, Backfill, and Grading. Refer to Section 16110-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 to ensure no disturbance of bearing soil under foundations.
- D. CONTRACTOR shall follow underground pipe runs where possible to avoid additional rock excavation. See Division 2 for rock excavation requirements.

### 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 which 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 which 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 which is to be installed or which 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. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.

### 3.11 WORKMANSHIP

- A. Install work using procedures defined in NECA Standard of Installation.
- B. Location of process equipment as shown on the drawings is approximate.

- C. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.
- D. Locations of utilization equipment and control devices as shown on 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.
- E. Unless otherwise noted, equipment shall be fastened to building structure or equipment framework and not placed on the floor.
- F. 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.
- G. Materials and equipment of the types for which there are National Board of Fire Underwriters' Laboratories (UL) listing and label service 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. Alterations:
  - 1. Alter, extend, and reconnect conduits as necessary.
  - 2. Reconnect existing conduits which were reused, cut, or exposed because of construction as quickly as possible.
  - 3. Where wiring is involved, new wires shall be "pulled-in" between the nearest available accessible reused outlets to the extent allowed by the governing code.
  - 4. Furnish and install new conduits for wires if they cannot be "pulled-in" to existing conduits.
  - 5. All new conduits, wiring, and electrical items shall be connected to the existing systems so as to function as a complete unit.
  - 6. Where existing electrical equipment, devices, fixtures, electrically operated items, etc., interfere with any remodeling work, they shall be removed and reinstalled in another location to avoid such interferences. All existing and relocated equipment shall be left in good operating condition.
- B. CONTRACTOR shall remove all conduit and wiring associated with items specified herein and/or shown on the drawings to be removed.
- C. Include in Bid removal of existing electrical material and equipment as specified hereinafter, as noted on the drawings, or as needed by field conditions.
- D. Provide stainless steel cover plates for all existing recessed outlet and junction boxes not being reused. Seal or cap all existing conduit penetrations not being reused.

END OF SECTION

## SECTION 16110

### 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. Intermediate metal conduit and fittings.
  - 4. Polyvinyl chloride conduit and fittings.
  - 5. Liquid-tight flexible metal conduit and fittings.
  - 6. Conduit seals and special fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI C80.1—Rigid Steel Conduit, Zinc-Coated.
- B. ANSI C80.6—Intermediate Metal Conduit.
- C. ANSI/NEMA FB 1—Fittings and Supports for Conduit and Cable Assemblies.
- D. NEMA RN 1—PVC Externally and Internally Coated Galvanized Rigid Steel Conduit.

##### 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 01300–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. Heavy wall seamless tubing with hot-dipped galvanized coating.
- B. Conduit bodies for rigid steel conduit shall be as manufactured by Appleton, Form 35, or 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. CONTRACTOR shall select body style and size per 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. Federal Specification WW-C-581 E
  - 2. ANSI C80.1
  - 3. UL6
  - 4. NEMA RN-1
- 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 7 style or pulling elbow and include pulling rollers, domed, gasketed covers and stainless steel screws. CONTRACTOR shall select body style and size per application.
- E. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded-type, material to match conduit.
- F. Supports: One-hole or two-hole pipe straps may be used for surface mounted conduit. Where one-hole straps are used, provide conduit clamp and back spacer. Where standoffs

are required, provide pipe straps and supporting devices as specified in Section 16190-Supporting Devices. Support material shall match that of the conduit type provided.

## 2.02 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Conduit: ANSI C80.6. Intermediate grade metallic tubing, seamless, with hot-dipped galvanized coating.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; use fittings and conduit bodies specified above for rigid steel conduit.
- C. Supports: One-hole or two-hole pipe straps may be used for surface mounted conduit. Where one-hole straps are used, provide conduit clamp and back spacer. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 16190-Supporting Devices. Support material shall match that of the conduit type provided.

## 2.03 POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

- A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and above ground 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 non-metallic clamps or conduit support straps may be used for surface mounted conduit. Where stand-offs are required, provide pipe straps and supporting devices as specified in Section 16190-Supporting Devices. Support material shall match that of the conduit type being provided.

## 2.04 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: Electro-galvanized single strip steel with PVC coating and integral grounding conductor. Liquid-tight conduit installed in exterior locations shall be sunlight resistant.
- B. Fittings: ANSI/NEMA FB 1.

## 2.05 CONDUIT SEALS AND SPECIAL FITTINGS

- A. Expansion Fittings: Crouse Hinds or Robroy type XJG, or equal, for rigid, IMC, or PVC-coated rigid conduit. Crouse Hinds, type XD, or equal for PVC conduit.
- B. Expansion-deflection Fittings: O-Z type "DX", Crouse Hinds, type XD (PVC conduit only), or Appleton.
- C. Ground Bushings: Appleton, model GIB, or equal.

- D. Mechanical Seals: 316 stainless steel, Link Seal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners.
- E. Watertight Hubs: Die-cast, insulated, and gasketed, rated for wet or dry locations, indoors or outdoors. Water tight hubs shall be Appleton HUB, Crouse-Hinds Myers Hubs, or equal.
- F. 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 liquid-tight 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.
- 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. Run conduits concealed to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid all materials and equipment of other trades. Maintain a minimum clearance of 6 inches from all hot water pipes, flues, or any high-temperature piping or duct work.
- F. 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.
- G. Center conduit in structural slabs (other than topping), clear of reinforcing steel and spaced on centers equal or exceeding three times the conduit diameter. Outside diameter of conduit shall not exceed 1/3 the slab thickness for each run of conduit 1 1/4 inches or larger. Provide shop drawings when it will be installed in structural slabs. Conduits shall not be run in slabs-on-grade or structural topping slabs.
- H. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice. Conduits through roofs shall be equipped with pitch pockets.
- I. Conduit installed in metal stud walls must be secured to prevent rattling.
- J. Conduit attached to building surfaces which 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 exterior locations, and all areas below grade.

- K. 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.

### 3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

- A. Interior conduit shall be run concealed in walls, building cavities, chases, attic spaces, and buried below floor slabs. Exterior conduit shall be buried below grade and concealed in structure walls. Exposed conduit runs shall be avoided. Conduit may be run exposed only where it is impossible to conceal.
- B. 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.
- C. PVC conduit installed in earth (interior and exterior) shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.
- D. 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.
- E. Where conduits installed through roofs serve heating, ventilating, and air-conditioning equipment, conduits may not be routed through ductwork or chases; conduits shall penetrate the roof and be equipped with pitch pockets.
- F. Conduits installed for future equipment or electrical work shall be cut-off and capped flush with finished floor. Conduit ends shall have threaded fittings to accommodate future conduit installation.
- 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. Exposed conduits shall be threaded and capped.
- H. Provide a 3/4-inch conduit from the telephone equipment room to the water service entrance.
- I. Provide conduit raceway for exposed cables that are not UV resistant. This shall include, but not be limited to, instrument wiring, motor terminators, pump cables, float cables, etc.
- J. Conduit seals shall be provided where conduits pass from the interior to exterior of the building.
- K. Liquid-tight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.

- L. All runs of liquid-tight flexible conduit 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 of liquid-tight flexible conduit shall be installed for each motor.
- M. Provide conduit expansion-deflection fittings as specified herein, in all conduit runs where movement perpendicular to axis of conduit may be encountered.
- N. 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.

### 3.03 CONDUIT PENETRATIONS AND TERMINATIONS

- A. Where fittings are brought into an enclosure with a knock-out, a gasket assembly consisting of an "O" ring and retainer shall be installed on the outside. Fittings shall be insulated throat-type.
- B. Conduit penetrations for control panels or enclosures containing electronic equipment shall be made on the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.
- C. Provide conduit expansion fittings as specified herein, in all conduit runs that cross a structural expansion joint, for conduits protruding from duct banks that are routed above grade and into structures, and for conduits protruding from earth where the conduit is terminated within 5 feet of finished grade.
- D. Provide firestopping for all conduits penetrating fire barriers as specified in Section 07270-Firestopping.
- E. All conduits that protrude from poured concrete shall be PVC coated rigid conduit. Conduit shall extend a minimum of four feet beyond the poured concrete (both sides).
- 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 consisting of one part Portland cement and three parts sand, by volume. Add sufficient water to make a stiff, placeable mortar.
- H. 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.

### 3.04 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. Structural slabs.

- b. Interior locations requiring mechanical protection.
  - c. Exposed interior locations.
  - d. All concealed interior locations.
2. IMC:
- a. Slabs, except slabs on grade.
  - b. All concealed interior locations.
  - c. Interior locations requiring mechanical protection.
  - d. Exposed interior locations.
3. PVC coated rigid steel:
- a. Conduits protruding from concrete.
  - b. Interior and exterior locations requiring mechanical protection.
  - c. Earth.
  - d. Exterior locations and locations exposed to weather.
  - e. Within 6 feet of building or structure footing, wall or manhole/handhole.
4. PVC:
- a. Earth, except within 6 feet of a building or structure footing, wall, or manhole/handhole. PVC conduit under pavement or roadways shall be Schedule 80.
  - b. Service entrance ground conductors.
  - c. Buried below slabs on grade.
  - d. NEMA 4X locations.
5. Liquid-tight flexible metal conduit not over 3 feet in length for final connections to:
- a. Equipment in wet locations.
  - b. Equipment with sliding bases or flexible positioning.
  - c. Equipment with vibration isolation mounting.
  - d. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including transformers and motors.
  - e. All pumps, fans, and associated equipment.

END OF SECTION

## SECTION 16112

### HANDHOLES

#### PART 1–GENERAL

##### 1.01 DESCRIPTION

- A. Work Included:
  - 1. Pre-cast polymer concrete handholes.
- B. Related Sections: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A48, Specification for Gray Iron Castings.
- B. ASTM C1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
- C. ASTM D4101, Specification for Polypropylene Injection and Extrusion Materials.
- D. ANSI/SCTE 77, Specification for Underground Enclosure Integrity.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.
- B. Shop drawing submittals shall include the following:
  - 1. Interior elevations of each wall of all handholes provided under this Contract. Each conduit shall be identified as to what it serves.
  - 2. Product Data (Handholes): Manufacturer's technical information for handholes and accessories proposed for use.

#### PART 2–PRODUCTS

##### 2.01 PRE-CAST POLYMER CONCRETE HANDHOLES

- A. Material and Construction:
  - 1. Precast Polymer concrete.
  - 2. Duct entrances sized and located to suit ductbanks.
  - 3. Enclosures shall be UL listed.
  - 4. Enclosures, boxes, and covers are required to conform to test provisions of ANSI/SCTE 77 for Tier 22 applications.
  - 5. All covers are required to have a minimum coefficient of friction of 0.50 in accordance with ASTM C1028.
  - 6. Covers shall have the following stamped logo based on the installation.

“FIBER-OPTIC” or “ELECTRICAL”

7. Handholes shall be Hubbel, Quazite, PG-Style, or equal.

### PART 3—EXECUTION

#### 3.01 INSPECTION AND COORDINATION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
- B. Coordinate handhole installation with piping, sheeting, and other underground systems and structures and locate clear of interferences.

#### 3.02 INSTALLATION

- A. Install handholes where shown and verify locations in field. Perform excavation and backfilling required for installation. Excavation and backfilling shall be per Section 16010-General Electrical Requirements.
- B. Install handholes on a 3/4-inch crushed stone foundation 1 foot under all handholes and within 2 feet of exterior of handholes. Handhole bases shall be set at the proper grade and carefully leveled and aligned.
- C. All conduits must enter the sides of handholes. Conduits entering the bottom will not be permitted.
- D. Handholes shall be considered wet locations for purposes of equipment selection.
- E. All conduits shall be pitched so that drainage is towards handhole and away from all structures.

#### 3.03 GRADING AT HANDHOLES

- A. Handholes in unpaved areas shall be built as shown to a rim elevation higher than the original ground. The ground surface shall be graded to drain away from the handhole. Fill shall be placed around handholes to the level of the upper rim of the handhole frame, and the surface evenly graded on a one (vertical)-to-five (horizontal) slope to surrounding ground, unless otherwise shown.
- B. Handholes in paved areas shall be constructed to meet final surface grade. In paved areas on state highways, handholes shall be 1/2-inch below final wearing surfaces. Handholes shall not project above finished roadway pavements.
- C. CONTRACTOR shall be solely responsible for proper height of handholes necessary to reach final grade. ENGINEER's review of Shop Drawings for handhole components is general in nature and CONTRACTOR shall provide random length precast handhole riser sections to adjust handholes to meet field conditions for final grading.

END OF SECTION

## SECTION 16120

### 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 1 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 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 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 01300–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 multi-conductor cable is NOT ALLOWED.
- B. Motor circuit branch wiring and associated control wiring:
  - 1. Insulation type shall be THHN (indoors, non-VFD application).
  - 2. Minimum size for motor control wiring shall be 14 AWG.
  - 3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on drawings.
- C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be type XHHW-2.
- D. All wiring within control panels and supervisory control centers shall be insulation type MTW, minimum size 16 AWG.
- E. Wiring in dry locations shall be THHN. Wiring in damp and wet locations shall be type XHHW-2. Damp and wet locations shall include but not be limited to exterior locations, unconditioned spaces, exterior buried conduits.
- F. All available colors shall be used; however, green shall be used only for equipment grounds. Where color-coded wire in larger sizes is not available, one wrap of 1-inch-wide, colored, self-adhesive tape at each terminal end shall be used for identification. 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.
- G. Color Coding:

	120/208V/240V	277/480V
A Phase	Black	Brown
B Phase	Red	Orange
C Phase	Blue	Yellow
Neutral	White	Gray
Travelers	Yellow	Orange
Equipment Ground	Green	Green

- H. Branch circuit wiring for exit lights, emergency lights, and exterior lights in excess of 75 feet shall be minimum 10 AWG.

## 2.02 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-con, 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 Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes. Spring wire connectors are not allowed for terminating of 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 one hole copper compression lugs for 6 AWG and larger, split bolt connector for 8 AWG and smaller, 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. One hole copper compression lugs shall be as manufactured by 3M, or equal, 30000 series. Lug size shall be selected based on motor and feeder wire sizes installed.
  - 3. Pigtail splice kit shall consist of one-hole lug cover, locking pin, silicone grease, and mastic sealing strip. 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 approved by ENGINEER. Where allowed, provide in-line splices for all conductor connections, 6 AWG and larger. Splice crimp component shall be Burndy copper compression splice long barrel, beveled entry, type YS, 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.

## 2.03 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed.
- B. Power Terminals: Unit construction-type, closed-back-type, with tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction-type, channel mounted; tubular pressure screw connectors, rated 300 volts.
- D. Manufacturer and Model Number: Phoenix Contact UK 5 N, or equal.

## PART 3-EXECUTION

### 3.01 INSPECTION

- A. Examine the areas and conditions under which the work is to be installed and notify CONTRACTOR of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

### 3.02 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 to ensure 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, motor control centers, 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, 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, MCCs, and panelboards.
- 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 cubicles, and similar equipment. This shall include all spare or unused wires.
- K. Provide preprinted adhesive or heat shrink-type wire numbering labels at all terminations and splices. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (e.g. Brady labels) are not acceptable.
- L. 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.
- M. Do not use a pulling means which can damage the raceway.
- N. Signal wiring (below 100 volts) 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.).
- O. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.

- P. 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.
- Q. Thoroughly clean wires before installing lugs and connectors.
- R. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.
- S. Terminate spare conductors within equipment, MCCs, 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 16195-Electrical Identification, for additional requirements.
- T. 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.

### 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, dry, and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Conductors #6 AWG and larger shall be pulled in to 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 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 hook-ups, energize circuitry and demonstrate functioning 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.

### 3.05 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 of 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. At the request of OWNER's representative, demonstrate by test the compliance of the installation with these specifications and drawings, the National Electrical Code, and the accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.
- E. 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.
- F. The transformer, feeder, and subfeeds to the lighting panels 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.

### 3.06 WIRE INSTALLATION SCHEDULE

- A. Install all wiring in raceways except as otherwise noted. This includes all low voltage wiring such as temperature control, instruments, network, etc.

END OF SECTION

## SECTION 16130

### BOXES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Wall and ceiling outlet boxes.
  - 2. Pull and junction boxes.
- B. Related Sections and Divisions: Applicable provisions of Division 1 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 01300–Submittals.

## PART 2–PRODUCTS

### 2.01 SWITCH, OUTLET, AND SMALL JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel, 4-inch square or octagon, minimum 2 1/8 inches deep. Raco, Appleton, or equal. Boxes with knockouts for multiple size conduits not allowed.
- B. Masonry and Partition Boxes: Galvanized steel, non-gangable. Thomas & Betts, GW Series, or equal. Provide number of gangs for devices shown on the drawings.
- C. Cast Boxes: Aluminum or cast feraloy, deep-type, gasketed cover, threaded hubs, Crouse-Hinds FD Series, or equal.
- D. 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.
- E. NEMA 4X Boxes: PVC or FRP, Carlon FS Series, or equal with proper cover and gasket.

### 2.02 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1: Code gauge steel with galvanized or sheradized finish, secured by galvanized machine screws. Hoffman ASG Series without knockouts, or equal.
- B. Cast Boxes: NEMA 250; Type 4, flat-flanged, surface-mounted junction box, UL-listed as watertight. Cast aluminum or feraloy box and cover with ground flange, neoprene gasket, and stainless steel cover screws, Crouse-Hinds WCB Series, or equal.
- C. 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.
- D. NEMA 4X Boxes: PVC or FRP, Carlon NS Series, or equal with proper cover and gasket.
- 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 drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.
- B. Electrical box locations shown on 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 approved by ENGINEER. Where approved by 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 which may be damp shall be spaced out to avoid rust and/or corrosion. All boxes in damp locations shall be on 1-inch standoffs. Damp locations shall include, but not be limited to, exterior locations, and all areas below grade.

### 3.02 SWITCH AND OUTLET BOX INSTALLATION

- A. Locate boxes in masonry walls for cutting of masonry unit corners only. Coordinate masonry cutting to achieve neat openings for boxes.
- B. Provide knockout closures for unused openings.
- C. Support boxes independently of conduit.
- D. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. Install boxes in walls without damaging wall insulation.
- F. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring shall have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g., 24V, 120V, 480V) shall have dedicated pull and junction boxes for each voltage.
- G. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- H. All concealed lighting outlet boxes shall be sheet metal octagon boxes.
- I. In plaster or concrete walls, single receptacle, single- or double-switch outlets, use 4-inch square masonry boxes fitted with raised plaster covers. In poured concrete walls below grade, use cast boxes.
- J. In unplastered brick or block walls use masonry boxes.
- K. In metal door frames use partition boxes.
- L. For weatherproof switches, devices, and exterior fixtures use cast boxes with proper cover and gasket.
- M. All exterior outlet boxes shall be NEMA 4X.
- N. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.
- O. Knock-out punches or saws shall be used for holes; boxes with pre-punched holes are not acceptable.

- P. 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 they will support the weight of the fixture. Conduit will not be considered as adequate supports.
- Q. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.

### 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 or saws shall be used for holes; boxes with prepunched holes are not acceptable.
- D. All junction boxes shall be labeled with permanent labels (not adhesive type). Permanent labels shall include painted stencil-type labels or engraved laminated nameplates. Labels shall indicate circuit or load served, as well as power source.
- E. All interior exposed junction and pull boxes shall be cast-type with cover, unless noted otherwise.
- F. All exterior junction and pull boxes shall be NEMA 4X. Boxes in areas subject to damage shall be stainless steel.

END OF SECTION

## SECTION 16141

### WIRING DEVICES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Wall switches.
  - 2. Receptacles.
  - 3. Cover plates.
  - 4. Control switches.
  - 5. Wall-mounted occupancy sensors.
  - 6. Ceiling-mounted occupancy sensors.
  - 7. Outdoor photo cells.
  - 8. Thermostats.
  
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. NEMA WD 1–General-Purpose 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 01300-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: Cooper 222\*, Leviton 122\*, or Pass and Seymour PS20AC\*.
- B. Provide ivory colored handles.
- C. Manual motor switches or manual motor controllers for 120V or 240V motors on circuits 20 amps or less shall be specification grade snap switch as specified above. Manual motor switches or manual motor controllers for 120V or 240V motors on circuits 30 amps or less shall be Cooper 303\*, Leviton 303\*, or Pass and Seymour PS30AC\*. Manual motor switches for three phase motors 30 amps or less shall be as specified in Section 16440-Disconnect Switches.

\*Complete catalog number for pole arrangement necessary.

### 2.02 RECEPTACLES

- A. 20 ampere, 125 volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Cooper 5362, Leviton 5362, Pass and Seymour 5362-A. Receptacles shall be mounted vertically. Provide ivory coloring.
- B. GFCI Receptacle: Pass and Seymour 2095, Cooper TRVGF20 receptacle with integral ground fault current interrupter. Receptacles shall be mounted vertically. GFCI receptacles shall not be series wired. Provide ivory coloring.

### 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. Surface boxes shall have plates to match Crouse-Hinds, Appleton, or equal cast boxes.
- B. Thermoplastic ivory cover plates shall be used in all "finished" areas.
- C. Weatherproof switch covers shall be Thomas and Betts, Industrial Gray, toggle switch cover, Model E98TSCN-CAR, or equal.
- D. While in-use receptacle covers for exterior use shall be Leviton M5979, or equal. Receptacle covers for NEMA 4X locations shall be Leviton 5976, or equal.

- E. Cover plates for manual motor switches or manual motor controllers shall have provisions for locking the switch in the On or Off position.

#### 2.04 WALL-MOUNTED OCCUPANCY SENSORS AND DOUBLE POLE (TYPE 2)

- A. The sensor shall use both passive infrared and ultrasonic detection methods for detecting room occupancy. The unit shall fit on/in a standard single-gang switchbox and shall require two wires and a grounded box for proper operation.
- B. The sensor shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to filter short wavelength IR, such as those emitted by the sun and other visible light sources.
- C. Sensor shall have selectable DIP switches to adjust automatic time delay to fit occupant usage patterns.
- D. The sensor shall operate at universal voltages of 100-300 VAC. Sensor shall be capable of switching line voltage loads without the use of relay power packs.
- E. Sensor shall have no minimum load requirement and shall be capable of switching from 0-800 Watt incandescent, 0-800 Watt fluorescent or 1/6 hp @ 120 VAC, 60 Hz.
- F. Double pole sensors shall have the capability of switching two independent line voltage circuits. Each pole shall have no minimum load requirement and shall be capable of switching from 0-800 watts incandescent, 0-800 Watts fluorescent or 1/6 hp @ 120 VAC, 60 Hz.
- G. Sensor shall not protrude more than 3/8-inch from the wall.
- H. Sensor shall have a 28-segment, two-level, Fresnel injection molded lens.
- I. Sensor shall cover up to 1,000 square feet for walking motion, with a field view of 180°.
- J. In automatic mode, sensor shall be able to automatically return to Automatic-on after lights are turned off manually.
- K. Sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.
- L. Sensor shall have a service switch to allow end-users to operate the sensor in the event of a failure, set by a DIP switch.
- M. Sensor shall be able to control incandescent, magnetic low voltage, electronic low voltage, and fluorescent loads.
- N. Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have ground wire and grounded strap.
- O. The PIR wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch.

- P. Double Pole wall mounted passive infrared occupancy sensor shall be Model DW-200 as manufactured by Wattstopper, or equal.

## 2.05 CEILING-MOUNTED OCCUPANCY SENSORS (TYPE 1)

- A. The sensor shall use both passive infrared and ultrasonic detection methods for detecting room occupancy. The unit shall fit on/in a standard octagon box and shall require two wires and a grounded box for proper operation.
- B. Sensors shall have selectable DIP switches to adjust sensitivity settings to fit occupants usage patterns.
- C. Sensors shall be mounted to the ceiling with a flat, unobtrusive appearance and provide 360° of coverage.
- D. Sensor shall utilize a temperature compensated dual element sensor and a multi-element Fresnel lens. Fresnel lens shall be a Poly IR 4 based material to filter short wavelength infrared, such as those emitted by the sun and other visible light sources.
- E. The sensors shall feature terminal style wiring.
- F. The sensor shall have a 34 element Extended Range lens.
- G. Sensor shall cover 360°, up to 2,000 square feet of walking motion with the Standard Lens mounted at 8 feet AFF.
- H. Sensors shall operate at 24 VDC/VAC and half-wave rectified and utilize a power pack.
- I. Power pack shall be a self-contained transformer and relay module and shall meet the following requirements.
  - 1. Power and auxiliary relay pack shall have 1/2-inch snap-in nipple for 1/2-inch knockouts. Power and auxiliary relay packs shall be mounted on the outside of junction boxes above suspended ceilings. If the occupancy sensor is installed in an unfinished exposed location sensor shall be installed within a junction box. The junction box cover shall be permanently labeled "OS Control."
  - 2. Power and auxiliary relay packs shall have dry contacts capable of switching 20 amp ballast load, 13 amp incandescent, 1 hp @ 120 VAC, 60 Hz.
  - 3. Power packs shall provide a 24 VDC, 150 mA output.
  - 4. Power packs shall be capable of parallel wiring without regard to AC phases on primary.
  - 5. Auxiliary relay packs shall be identical in physical size of power packs and contain no transformer power supply and shall switch 120 VAC.
  - 6. Power pack and auxiliary relay packs shall be UL 2043 rated, use UL 94 V-O plenum rated plastic, and have low voltage Teflon coated leads, rated for 300 volts.
  - 7. Power and auxiliary relay packs shall be UL and CUL listed.
  - 8. Power and auxiliary relay pack shall be Model OSP20 as manufactured by Leviton, or equal.
- J. The sensor shall have an additional single-pole, double throw isolated relay with normally open, normally closed, and common outputs.

- K. Sensors shall have a time delay that is adjusted automatically or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.
- L. The sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that requires less visibility.
- M. Ceiling mounted motion sensor shall be Model OSC20-M0 as manufactured by Leviton, or equal.

## 2.06 OUTDOOR PHOTOCELLS

- A. Photocell controller shall be rated 2000 watts tungsten at 120, 240, or 277 volts. The photocell shall be cadmium sulfide, 1 inch diameter, gasketed for maximum weatherproofing.
- B. Photo-cell mounting shall include a weatherproof wall plate with neoprene gasket suitable for attachment to an approved outdoor junction box.
- C. Photocell controller shall include a delay of up to two minutes to prevent false switching. On-activation shall occur at 1-5 footcandles; off-deactivation shall occur at 3-15 footcandles.
- D. Operational temperature range shall be -40°F to 140°F (-40°C to 60°C). All photocells shall be UL listed and include a 5-year warranty.
- E. Photocell shall be Intermatic, or equal, K4000 Series with weatherproof wall plate, light shield, and neoprene gasket. Install where shown on the drawings.

## 2.07 THERMOSTATS

- A. Line voltage thermostats for single stage heating or single stage cooling shall be Honeywell T6051A. Line voltage thermostats for high and low temperature alarms shall be Johnson Controls Model A19BAC-1. Line voltage thermostats for single stage heating, single stage cooling, or high and low temperature alarms in NEMA 4X areas shall be Honeywell T631F.
- B. Thermostats shown on the drawings shall be single stage unless otherwise noted.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Install wall switches 42 inches above floor (top of box), "Off" position down, except as otherwise noted.
- B. Install convenience receptacles 15 inches above floor (bottom of box), grounding pole on bottom except as otherwise noted.
- C. Install specific-use receptacles at heights shown on Contract drawings.

- D. Install thermostats 48 inches above floor (top of box).
- E. Convenience Receptacles: Specification grade self-grounding.
- F. Install devices and cover plates flush and level.
- G. Backwiring is not allowed for switches and receptacles. Wires shall be terminated with the device screw terminal.
- H. 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 Pan Net 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. Hand-written labels are not acceptable.

END OF SECTION

SECTION 16190  
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 1 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 01300–Submittals.

PART 2–PRODUCTS

2.01 MATERIAL

- A. Support Members:
  - 1. 316 stainless steel, fiberglass, or PVC in exterior locations. PVC coated steel where used with PVC coated conduit.
  - 2. Galvanized steel in all other areas.
- B. Hardware:
  - 1. Stainless steel in exterior locations.
  - 2. Galvanized steel in all other areas.
- C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. 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 stand-offs as specified in other technical sections.

- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Where support members are used for conduit, cut-off ends shall be ground smooth. Cut-off PVC-coated support members shall be ground smooth and touched-up with PVC coating material from the manufacturer.
- D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- E. Do not use powder-actuated anchors.
- F. Do not drill structural steel members.
- G. 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.
- H. In wet locations install free-standing electrical equipment on concrete pads. Anchor all equipment to adjacent walls with stand-offs and caulk.
- I. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Do not use chain hangers.
- L. All welds shall be continuous and ground smooth.

END OF SECTION

## SECTION 16195

### 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 1 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–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. Each device in Motor Control Centers.
    - d. SPD.
    - e. Cabinets, enclosures, pull, and junction boxes.
    - f. Field devices (flowmeter transmitters, etc.).
  - 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 MCC schedule, 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:
    - a. Motor Control Centers.
    - b. Supervisory Control Centers.
    - c. Panelboards.

- d. Transformers.
  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 wireway.
- C. Type "C":
  1. Use: Control stations, 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.
- D. Type "D":
  1. Use: Identify Supervisory Control Center communication and I/O modules.
  2. Size: As necessary.
  3. Material: 3-layer laminated Micarta.
  4. Background Color: Black.
  5. Character Color: White.
  6. Character Size: 1/8-inch.
  7. Engraving: Operating function.
  8. Mounting Location: As requested by ENGINEER.
- E. Type "E":
  1. Use:
    - a. Electrical Distribution System Equipment not previously specified.
    - b. Fire Alarm System.
  2. Size: As necessary.
  3. Material: 3-layer laminated Micarta.
  4. Background Color: Yellow.
  5. Character Color: Black.
  6. Character Size: 3/16-inch.
  7. Engraving and Mounting Location: As requested by ENGINEER.
- F. Type "F":
  1. Use: Operator instructions.
  2. Size: As necessary.
  3. Material: 3-layer laminated Micarta.
  4. Background Color: Yellow.
  5. Character Color: Black.
  6. Character Size: 3/16-inch.
  7. Engraving and Mounting Location: As requested by ENGINEER.

## 2.02 LABELING TAGS

- A. Use: Field-mounted devices (valves, limit switches, etc.).
  - 1. Size: 1-inch by 3-inch.
  - 2. Material: 1/32-inch-thick stainless steel.
  - 3. Character Size: 1/4-inch.
  - 4. Engraving: As requested by ENGINEER.

## 2.03 WIRE MARKERS

- A. Wire markers shall be permanently attached sleeve or heat shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wrap around numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.
- B. Wire markers shall be specifically printed for this project using permanently attached computerized adhesive tags, such as Brady IDXPRT labeling printer with self laminating vinyl, permaleeve heat-shrink polyolefin, or equal. Hand-written markers are not acceptable.

## 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 stainless steel screws in outdoor locations and stickyback adhesive in indoor locations.
- D. Affix labeling tags with permanent bonding cement or locking wire ties. 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. 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, motor control centers, supervisory control panels, 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.

END OF SECTION

## SECTION 16412

### 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 1 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 any 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 01300–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 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 (service entrance) and location category B3 (branch panels). Testing shall be per ANSI/IEEE C62.45–2002 using ANSI/IEEE C62.41 Category C3 and B3 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 480Y/277 volt systems.
  - 1. L-N = 1500V.
  - 2. L-G = 1500V.
  - 3. N-G = 1200V.
  - 4. L-L = 2500V.

## 2.02 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 160 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 16,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating ( $I_n$ ) of 10 kA.
- B. The SPD shall have a minimum Short Circuit Rating (SCCR) of 100 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 solidstate 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. Service entrance devices shall be as manufactured by MCG, 160M Series, Liebert LM, 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, as approved by 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 16420

### 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. Sequencing, scheduling.
  - 6. Underground electrical service.
- B. Allowances: 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 1.07–Underground Electrical Service.
- C. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 UTILITY COMPANY

- A. The Utility Company is Madison Gas and Electric.

##### 1.03 SECONDARY SERVICE CHARACTERISTICS

- A. The secondary service will be 480 volt, 4 wire, 3 phase.

##### 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 SEQUENCING, SCHEDULING

- A. Provide electrical service system, except the Utility Company will provide:
  - 1. “Window” type current transformers to be installed by CONTRACTOR in CT compartment of the MCC.
  - 2. Cable from ATS to MCC main circuit breaker.
  - 3. Cable from transformer to ATS.
  - 4. Meter.

1.06 UNDERGROUND ELECTRICAL SERVICE

- A. Provide complete underground electrical service except for items furnished and installed by the Utility Company.
- B. Coordinate the new electrical service with the Utility, and all Utility costs shall be included in the lump sum bid. All costs associated with temporary service of any type shall be included in CONTRACTOR's bid and will not be paid for as a part of the allowance. An allowance of \$1,000 shall be included in the lump sum bid to be adjusted at final payment in accordance with actual utility charges.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 INSTALLATION

NOT APPLICABLE

END OF SECTION

SECTION 16440  
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 1 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 01300–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 or Cutler Hammer Type DH.
- B. Manual Motor Switches: Square D, Class 2510 Type K or Cutler Hammer B330.
- 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.
- B. Manual Motor Switches: Where noted on the drawings, manual motor switches shall be provided for three phase motors with circuit rating of 30 amps or less. Manual motor switches shall have toggle operator without overload protection or indicator light. Provide

cover plate for all switches to meet the finish or classification of the space. Cover plate shall have provisions for locking the switch in the On or Off position.

#### 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 120V or 240V, single phase, shall be provided with a specification grade wall switch as disconnecting means. See Section 16141-Wiring Devices for additional information.

#### 2.04 ENCLOSURES

- A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the drawings:
  - 1. Indoor: NEMA 12, steel.
  - 2. Outdoor, corrosive or wet location: 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 approved by ENGINEER based on field conditions.
- B. Provide wall switch for each single phase fractional horsepower motor where indicated on the drawings.
- C. 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.
- D. 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 where approved by ENGINEER. Splices and spring wire connectors are not allowed within disconnect enclosures.

END OF SECTION

SECTION 16450  
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 1 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 01300–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-Cadweld, Thomas & Betts compression type, or equal. Compression connectors shall be prefilled with an oxide inhibitor.
- C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, KG, GBL, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Compression type connectors shall be installed with the manufacturer recommended tools. Compression dies shall emboss index on the connector when installed correctly. An indenter crimp shall be made on ground rods prior to connection of grounding conductor.
- B. 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.

- C. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold water plumbing systems.
- D. Connect grounding electrode conductors to metal water piping, metal frame of building or structure, and structural reinforcing bars using suitable ground clamps. Make connections to flanged piping at a point ahead of meter or service shutoff valve. Provide jumper connection across meter on service shutoff valve.
- E. Ground system, transformer neutrals and equipment as required by code and local ordinances.
- F. All feeder neutrals shall be connected to neutral at only one point in the MCC or switchgear.
- G. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.
- H. Water system grounds and a minimum of three ground rods at 15-foot separations near service entrance of each building shall be provided and ground wires must attach to point ahead of meter or service shutoff valve. These shall be connected to ground bus by conductors sized to code requirements. The above are minimum requirements.
- I. All service entrance grounding electrode conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90° bends are not allowed.
- J. Include ground for grounded receptacles, light fixtures, telephone system, motors, and equipment items shown on drawings.
- K. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, lighting fixture, or equipment frame to conduit system.
- L. 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.
- M. All equipment in NEMA 4X areas that are fed from circuits in PVC conduit shall be provided with a separate green ground wire that is terminated at the metallic conduit system and the equipment.
- N. 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 transformers.
- O. Refer to Specification Section 16930—Instrument 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.
- C. The test meter shall be Associated Research Vibroground test set with null balance, James A. Biddle Megger Earth-Tester-Null Balance, or approved 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. In lieu of testing the ground grid as a system, CONTRACTOR may choose to test individual ground rods separately. Individual ground rods when tested separately 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 16450. Each ground grid, including service entrance transformers, shall have a form submitted.

END OF SECTION



SECTION 16480  
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.
  - 4. Solidstate starters.
  - 5. Variable frequency drives.
  - 6. Motor control centers.
  
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 1–GENERAL .....	1
1.01 SUMMARY.....	1
1.02 REFERENCES .....	1
1.03 SUBMITTALS.....	2
1.04 OPERATION AND MAINTENANCE DATA .....	2
1.05 DELIVERY, STORAGE, AND HOLDING .....	2
1.06 SPARE PARTS .....	2
1.07 COORDINATION .....	2
PART 2–PRODUCTS.....	3
2.01 ACCEPTABLE MANUFACTURERS .....	3
2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS.....	3
2.03 MAGNETIC MOTOR STARTERS .....	4
2.04 SOLIDSTATE STARTERS.....	5
2.05 VARIABLE FREQUENCY DRIVES.....	6
2.06 COMBINATION MOTOR STARTERS.....	10
2.07 MOTOR CONTROL CENTERS .....	10
PART 3–EXECUTION.....	13
3.01 INSTALLATION .....	13

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 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

#### 1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01300–Submittals.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.05 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.

#### 1.06 SPARE PARTS

- A. Furnish spare parts for equipment specified herein as listed in Section 16951–Spare Parts.

#### 1.07 COORDINATION

- A. To assure proper coordination between Section 16940-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 16940. This shall include, but not be limited to, equipment such as MCCs, combination starters, and control stations. Drawings for MCCs, combination starters, motor controllers, and motor control equipment shall be provided by the Section 16940 System Supplier. Drawings from equipment manufacturers will not be accepted as shop drawings or O&M documents.

## PART 2–PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Motor control devices, motor starters, variable frequency drives, and motor control centers 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. Pushbuttons: NEMA ICS 2; heavy-duty, oil-tight, (30 mm) as shown on the drawings.
- C. Indicating Lights: NEMA ICS 2; heavy-duty, oil-tight, (30 mm), LED, push-to-test type as shown on the drawings.
- D. Selector Switches: NEMA ICS 2; heavy-duty, oil-tight, (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, 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 3PDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120VAC.
    - d. Contact rating: 15A, 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: 120VAC.
  - d. Contact rating: 20A continuous; 1 hp.
  - e. Operating life: 10 million cycles.
  - f. UL listed.
  - g. NEMA rated.
  - h. Manufacturer: Allen Bradley, 700-PK, or equal.
- J. All starters shall be equipped with the auxiliary devices to meet the requirements of the plans 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 Stand-Alone Controllers, Starters, and Control Devices:
- 1. Enclosures in indoor, dry locations shall be NEMA 1 gasketed.
  - 2. Enclosures in indoor damp or wet locations, outdoor locations, or locations below grade shall be NEMA 4X, stainless steel.
  - 3. 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.
  - 4. 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.
  - 5. Control stations shall include devices as shown on the drawings and specified in Section 16940-Controls and Instrumentation.
- L. Hard-wired Motor Controls:
- 1. Equipment and wiring specified to be hard-wired 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 setup 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 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 solidstate overload relay, Allen Bradley E1 Plus, Bulletin 592-EE, or equal. Starters for submersible pumps, mixers, and 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 drawings. Contactors shall be Allen Bradley, Bulletin 509, or equal.
- E. Overload relays without DeviceNet communications shall have the following features:
  - 1. Self-powered, solid-state.
  - 2. Up to 5:1 adjustment range.
  - 3. DIP switch settings for trip class and reset mode.
  - 4. Current transformers (no heaters).
  - 5. Thermal memory.
  - 6. Ambient temperature compensation.
  - 7. Visible trip indicators.
  - 8. Phase loss protection.
  - 9. Low energy consumption.
- F. Magnetic motor starters 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 motor control centers and combination motor starters.

## 2.04 SOLIDSTATE STARTERS

- A. Starters where called for shall be reduced voltage solidstate starters. These starters shall be constructed with NEMA rated (as previously specified) wall-mounting motor control center type construction and located in the specified MCC as shown on the drawings. The starters shall be furnished with the following features:
  - 1. Output Stage: 6 SCRs; full-wave in-line control.
  - 2. Ambient Temperature: Operating range, 0 to 50°C at rated current.
  - 3. Transportation and Storage Range: 35° to 65°C (-30° to 149°F).
  - 4. Input Adjustments:
    - a. Initial step and voltage: 0 to 50%.
    - b. Current limit: 75% to 350%.
    - c. Acceleration time: 0 to 30 seconds.
    - d. Deceleration time: 2 to 60 seconds.
    - e. Trip running current: 75% to 150%.
  - 5. SCR Peak Inverse Voltage (PIV Rating):
    - a. Line voltage 208 to 480V: Continuous.
    - b. SCR rating 1400V.
  - 6. Transient Voltage Suppressor: Provide accessory protective module to protect against high-potential transient voltage spikes, model 150-F84, sized based on motor horsepower.
  - 7. RC Snubber Network: To prevent false firing due to dv/dt characteristics.
  - 8. Hard Firing Gate Pulse: A combination of high potential gate pulse and a rapid rise time to prevent SCR damage due to di/dt stress.
  - 9. Overload Capacity:
    - a. Continuous: 115% full load capacity.
    - b. One minute: 250%.
    - c. Thirty seconds: 450%.
    - d. Five seconds: 650%.
  - 10. Electronic Fuse: Overload trip capacity acts as an electronic fuse, which replaces the I<sup>2</sup>T fuses. Should a fault occur, the unit will trip out in one-cycle or less.

11. Modularity: For ratings/amps to 1200 Amps, the power structure shall consist of three power poles with integral heat sinks.
  12. Communications: A DPI serial communication port shall be provided as standard. Optional communications protocol interface modules shall be available for connection to Remote I/O, DH485, ControlNet, DeviceNet and RS232/422/485.
- B. Provide the following trip features:
1. Overcurrent trip.
  2. Phase Fail trip.
  3. Current Imbalance trip.
  4. Excessive starts per hour.
  5. Stall and jam detection.
  6. Underload protection.
  7. Undervoltage protection.
  8. Overvoltage protection.
  9. Voltage unbalance.
- C. Provide Ethernet communications module (20-COMM-E) for each starter so that signals noted in the I/O list—Section 16990 are transmitted/received via the plant SCADA system Ethernet network.
- D. Provide an isolation contactor on the input of each starter.
- E. Solidstate starters shall be Allen Bradley heavy-duty, Bulletin 150, SMC Flex, or equal. All nonpositive displacement equipment shall be furnished with Allen Bradley pump control option.
- F. Solidstate motor starters shall be combined with thermal-magnetic molded case circuit breakers.

## 2.05 VARIABLE FREQUENCY DRIVES

- A. A variable frequency drive (VFD) system consists of enclosed inverter, motor starter, bypass system when specified, motor, and any additional system control as specified. VFDs shall be provided to match the load type (constant or variable torque) of the specification application, as well as the full load amps of the motor furnished for the project.
- B. System Operating Conditions:
1. 480 VAC  $\pm$ 10%.
  2. 3 phase, 3 wire, any phase sequence.
  3. 60 Hz  $\pm$ 2%.
  4. Storage temperature -25°C to +55°C.
  5. Operating temperature 0 to 40°C.
  6. Altitude: 3,300 feet above sea level maximum.
  7. Humidity: 95% noncondensing maximum.
- C. Variable Frequency Unit:
1. Conform to NEMA and NEC standards.
  2. C.S.A. and ETL approved and/or UL approved.

3. Overall VFD efficiency shall be a minimum of 96.5%,  $\pm 1\%$ , at 100% speed and motor load at nominal line voltage. Efficiency rating shall include control power supplies, control circuits, and all cooling fans.
4. Input:
  - a. Withstand without component failure, line voltage transients up to 3,000 volts per ANSI C37.
  - b. Design to include DC bus chokes (2) to be used in conjunction with one or more capacitors. The DC bus chokes are to be incorporated in the design to minimize line side harmonics. Magnetic only designs need to include line filters to limit harmonics to a value no greater than in a system using dual DC bus chokes.
  - c. Include MOV line side protection.
  - d. Inverter input for six pulse VFDs shall have a true power factor of 0.95 or better at rated load and nominal line voltage throughout the entire speed range. Units shall be capable of operating attached to the same power bus without affecting each others operations. If operational problems occur, an isolation transformer shall be added to each drive at no additional Contract cost.
  - e. Three percent line reactors (drives smaller than 100 hp).
  - f. Drives larger than 40 hp shall include fuses on the drive input.
5. Inverter Output:
  - a. Inverter shall utilize latest generation IGBTs, be microprocessor based, and isolated from power circuits.
  - b. Match motor specified.
  - c. 3 phase, 3 wire.
  - d. Pulse width modulated wave form with selectable Sensorless Vector, Flux Vector, Volts/Hertz, and adjustable voltage control modes.
  - e. Maximum output 460 volts.
  - f. Frequency 2 to 650 Hz.
  - g. Frequency accuracy  $\pm 1\%$  of setting at any point in the specified speed range, in a 24-hour period.
  - h. Full load output current shall be rated in excess of the AC motor selected.
  - i. Motor performance:
    - (1) 3% regulation in the manual speed control mode.
    - (2) Normal duty overload rating: 110% continuous current for 1 minute; 150% for 3 seconds.
    - (3) Heavy-duty overload rating: 150% continuous current for 1 minute; 180% for 3 seconds.
    - (4) 110% starting torque minimum.
6. AC drive features:
  - a. Embedded I/O for discrete and analog signals. Analog signals shall include 4-20 mA circuitry mounted on separate printed circuit board to include offset, slope, minimum clamp, separate acceleration and deceleration adjustments from 0 to 3600 seconds. A light emitting diode is to be provided to show signal presence and an internal manual speed potentiometer is to be supplied for simulating the 4-20 mA input for start-up and maintenance. The circuit is to be designed to accept either a positive or negative signal, grounded or ungrounded.
  - b. Slot-based architecture for expansion control and communication cards including Ethernet/IP, ControlNet, discrete I/O, and analog I/O.
  - c. Real-time clock with battery for date/time stamping of events.
  - d. Integral thermostat control of door-mounted cooling fans.
  - e. Current limit circuitry: 0.1 amps to 160% of drive-rated amps.
  - f. Additional features for constant torque units shall include:

- (1) IR compensation to provide automatic voltage boost or reduction to optimize both starting torque and system input KW.
  - (2) Slip compensation to provide 0.5% regulation with a 100% load change.
  - (3) Inner current loop regulator.
7. Enclosures:
  - a. The VFD system shall be furnished with NEMA rated (as previously specified) floor mounting MCC structure or structures. MCC structures shall be 91 1/2 inches high by 20 inches deep with a width to accept the unit specified. MCC structure to incorporate bus where field wiring can be reduced.
  - b. Items to be mounted in the VFD structure or structures.
    - (1) Inverter.
    - (2) Incoming door interlocked, thermal-magnetic, molded case circuit breaker.
    - (3) Bypass circuitry when specified with incoming circuit breaker and NEMA rated mechanically interlocked contactors with separate overload.
  - c. NEMA 4/13 items to be door mounted on the MCC structure or portion of the structure:
    - (1) Power On light.
    - (2) Control devices, pilot lights, selector switches, etc., as shown on the drawings and specified herein.
    - (3) Interface to the drive shall be via a removable Human Interface Module (HIM) with integral display. This unit shall be a 7 line by 21-character backlit LCD display with graphics capability. HIM shall be used to display drive operating conditions, fault/alarm indications, and programming information with full text support in multiple languages. The LCD HIM shall be rated IP20/Type 1 and may also be used as a handheld terminal by connecting via a separate cable. The HIM keypads shall include programming keys, drive operating keys (Start, Stop, Direction, Jog, and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow drive programming or operating functions to be accessed directly without knowledge of programming structure. The HIM unit shall be mounted on the front of the enclosure door so the operator does not have to open the enclosure to access the HIM.
  - d. NEMA 4/13 items to be door mounted on the bypass structure or portion of the enclosure/structure where applicable:
    - (1) Power On light.
    - (2) Control devices, pilot lights, selector switches, etc., as shown on the drawings and specified herein.
8. Interlocks:
  - a. Fault contact to terminals.
  - b. VFD run contact to terminals.
  - c. Bypass run contact to terminals.
9. VFD protection:
  - a. Adjustable current limit of 20 to 160% minimum.
  - b. Instantaneous overcurrent trip.
  - c. Electronic ground fault and short-circuit protection to shut down the drive without fuse or component failure. Electronic ground and short-circuit protection to be functional with an input line of 480 VAC plus and minus 10%. The drive manufacturer is to be prepared to demonstrate ground fault and short-circuit protection without the use of an isolation transformer at drive start-up.
  - d. Input thermal-magnetic ambient compensated circuit breaker with a through-the-door interlocked operator.

- e. Shutdown on loss of any input phase for longer than 3 cycles.
  - f. Output phase sequence to be independent of input phase sequence.
  - g. High or low sustained voltage.
  - h. 120 VAC grounded control circuits.
  - i. Electrically and/or optically isolated low voltage logic.
  - j. Corrosion protection:
    - (1) Gold-plated plugs (male and female section) on all printed circuit boards.
    - (2) Protective board coating (conformal coating).
  - k. MOV converter protection.
  - l. DC bus chokes to minimize line side current harmonics.
  - m. Additional features for constant torque units:
    - (1) I<sup>2</sup>T protection to provide 150% current for one minute.
    - (2) Regenerative override protection.
10. VFD adjustments:
- a. Maximum speed: 50 to 100%.
  - b. Minimum speed: 0 to 70%.
  - c. Current limit: 20 to 110%, 160% on constant torque units.
  - d. Linear acceleration 0 to 3,600 seconds.
  - e. Linear deceleration 0 to 3,600 seconds.
  - f. Output volts/Hz trim.
  - g. Voltage boosts.
  - h. Additional features for constant torque units:
    - (1) Slip compensation.
    - (2) IR compensation.
  - i. All drives shall attempt to restart three times prior to indicating failure.
11. Inverter digital or LED diagnostic features:
- a. Current limit signal.
  - b. Regenerative override signal.
  - c. External fault (ex. motor overload).
  - d. Low line voltage.
  - e. High line voltage.
  - f. Current overload.
  - g. High DC bus voltage.
  - h. Current trip.
  - i. Short-circuit.
12. Inverter construction:
- a. Modular construction-ease of maintenance.
13. Mount modules on enclosure subpanel.
- a. Easily accessible from front.
  - b. Interconnect with plugs.
  - c. Construct boards of fire retardant materials in accordance with NEMA grade FR4 specifications.
- D. Inverter Quality Control:
- 1. Test all power devices at rated temperature and current for dv/dt, tq, TRR, and leakage.
  - 2. Test integrated circuits for programmed parameters at rated temperature.
  - 3. Treat printed circuit boards for corrosion resistance (conformal coating).
  - 4. Provide gold-plated connections at all points where plugs are used.
  - 5. Thermal cycle all printed circuit boards for ten cycles between 0° to 65°C prior to installation in inverter.

6. All units to be tested at a rated load and temperature after assembly.
- E. The variable speed drives shall be Allen Bradley, or equal, Powerflex 753. All drives shall be by the same manufacturer.
- F. Minimum, maximum, and harmonic skip speed setpoints shall be programmed into each VFD. CONTRACTOR shall coordinate these setpoints with the manufacturer of the equipment served.
- G. Provide expansion I/O cards, quantity as required, so that signals noted in the I/O list are transmitted/received via the plant SCADA system from the Ethernet network.
- H. Provide Ethernet communications module (20-COMM-E) for each drive so that signals noted in the I/O list–Section 16990 are transmitted/received via the plant SCADA system Ethernet network.
- I. Drive manufacturer shall provide a motor terminator output filter for Booster Pump (BP-15-01). Output filter shall be manufactured by Allen Bradley, Model 1204-TFB2, or equal.
- J. Provide manufacturer certified start-up and warranty service for each VFD. Service shall be for two years and include all travel and expenses. Warranty service shall commence at the date of substantial completion.

## 2.06 COMBINATION MOTOR STARTERS

- A. Magnetic motor starters not installed in motor control centers 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, 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. Nonfusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle lockable in “Off” position.
- E. Combination starters shall be Allen Bradley, Bulletin 513, Cutler Hammer, or Square D.

## 2.07 MOTOR CONTROL CENTERS

- A. Starters and disconnect devices for motors shall be installed in motor control centers, except where shown to be remote mounted at the motor location. Starters and disconnect

devices shall be NEMA rated, sized according to application as specified. The MCC and NEMA Class IIB drawings shall be supplied as part of the Controls and Instrumentation package described in Section 16940—Controls and Instrumentation. MCC drawings provided by the MCC manufacturer or through any CONTRACTOR will not be accepted as shop drawing submittals or O&M documents. System Supplier described in Section 16940—Controls and Instrumentation shall wire and test all MCCs for the functions described herein in their shop prior to shipment to the site. Provide one copy of the test report to ENGINEER.

- B. It shall be assumed that colors will be selected by OWNER and shall be nonstandard. Color shall match that specified for control enclosures specified in Section 16940-Controls and Instrumentation.
- C. Auxiliary contacts shall be of quantity necessary for equipment functions.
- D. Motor Control Center design shall be in accordance with latest applicable NEMA standards, shall have been tested to prove adequate mechanical and electrical capabilities, and all major components shall have been individually tested.
- E. Structures shall be totally enclosed dead front, free standing vertical sections, 90 inches high and not less than 20 inches deep for front mounted units and not more than 40 inches deep for units mounted back-to-back. Each vertical section shall have side panels extending the full height of the section to minimize fault-propagation to adjacent sections.
- F. Each structure shall contain a main horizontal bus continuously braced within each section, with rating as specified, and vertical buss feeding unit compartments with a minimum rating of 300 amperes, or as necessary for load and feeder breakers. All horizontal and vertical buss of all MCC sections shall be powered regardless of location of transfer switch, unless otherwise noted. All motor control centers shall include a 1/4-inch by 2-inch ground buss. All buss shall be tin-plated copper and braced to withstand short-circuit currents as indicated.
- G. Structures shall contain a horizontal wire-way at the top, isolated from the horizontal bus, and shall be readily accessible by removal of its cover plate. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference and safely accessible without disrupting service.
- H. A vertical wireway with a minimum of 28 square inches of cross sectional area shall be adjacent to each vertical unit compartment and shall be covered by its own door. These vertical wire-ways shall be free of all live parts and shall contain cable supports. Exceptions to this are as shown on the drawings.
- I. All units shall be provided with a mechanical interlock with the unit door to prevent access unless the disconnect is in the off position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect.
- J. Padlocking facilities shall be provided to positively lock the disconnect in either the on or off position with from one to three padlocks whether the door is open or closed.

- K. All unit heights shall be of modular dimensions to allow for unit layout, in any combination, without structural interference. Drawout units shall have a tin-plated stab assembly for connection to the vertical buss; no wiring to these stabs shall extend into the bus compartments. All buss access openings shall be provided with automatic shutters that close when the unit (e.g. starter, breaker), is withdrawn.
- L. Terminal blocks for NEMA Type B assemblies shall be mounted within the unit and shall be factory wired. Provide a minimum of 25% spare terminals for all terminal blocks furnished.
- M. Control centers shall be NEMA Class II.
- N. Wiring in Control Centers shall be Type B. All conductors supplying power from the MCC buss to frame-mounted equipment shall have the phases identified as specified in Specification Section 16120.
- O. Provide neutral landing lugs for all motor control centers accepting utility service-entrance conductors. Neutral landing lugs shall be bonded to the ground buss at the utility service entrance, unless otherwise noted.
- P. Control Centers shall include NEMA 1 gasketed enclosures, unless otherwise noted.
- Q. Remote mounted controls shall be heavy-duty, oil-tight (30 mm) of same quality and type furnished in starters and as shown on the drawings. Equipment controls that require a manual reset shall be accomplished through a reset pushbutton on the enclosure or motor control center bucket for the associated piece of equipment. All reset buttons shall be appropriately labeled, including mechanical type.
- R. Motor control center enclosures must be in accordance with area designations shown on drawings.
- S. All lighting and small power transformers shall be dry-type, Class H insulation, 80°C rise (KVA as indicated on drawings). Coil windings shall be copper, glass taped, dipped in silicone varnish, with two taps 2 1/2% above and below, 480-volt primary, Delta with 120/208-volt, three-phase, 4 wire secondary, unless indicated otherwise.
- T. All lighting panelboards shall be Cutler Hammer Pow R-Line 1a, or equal, with 10,000 amp interrupting capacity, at 120/208-volt, three-phase, 4 wire with branch breakers as shown on drawings, unless indicated otherwise. Branch mounted main circuit breakers will not be allowed. Minimum size shall be 20 inches wide by 5 3/4 inches deep. All bus shall be copper. Provide laminated, type-written panel schedule for all panelboards at project final completion.
- U. All motor control centers shall be factory assembled, wired, and tested. All internal wiring shall be color coded, numbered, and each wire shall be terminated on terminal strips, including internal spares, field wiring, and spare field wires. 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.
- V. Arrangement and physical locations of all equipment within each motor control center shall be subject to shop drawing approval.

- W. All components shall be properly identified with laminated engraved nameplates with 3/8-inch-high letters (white or black). Nameplates located outdoors shall be mechanically fastened. Nameplates located indoors shall be adhesive type.
- X. Unless otherwise indicated, all conduit entrances shall be through the bottom only.
- Y. Motor Control Center interrupting rating shall be as shown on the drawings, minimum 42,000A.
- Z. The main service breaker of MCC shall be provided with a surge protection device and a 3 phase monitor. This surge protection device shall be on the load side of the main and be as specified in Section 16412. The 3 phase monitor shall be on the load side of the main and be Timemark \*269, or equal. CONTRACTOR to select voltage to match electrical service. The 3 phase monitor shall be hard-wired to a red, push-to-test indicating light on the MCC bucket door for indication of "Three Phase Fail." This shall be in addition to PLC I/O or hard-wired interlocks.
- AA. MCC shall be provided with a power meter and appropriately sized Current Transformers (CTs). Power meter shall be Allen Bradley, or equal, catalog number 1408-EM3A-\* with Bulletin 1411 CTs. Power meter shall be provided with communication module to match the SCADA system communication protocol such that all readings available from the power meter can be integrated into the SCADA system. Power meter shall be installed in an MCC bucket as shown on the drawings, and power to meter shall include a disconnect within the MCC bucket for 120-volt power and 480-volt power. CTs shall be provided with shorting blocks.
- BB. Main Breaker: Molded case circuit breaker, 3 pole, 800 amperes as shown on the drawings with lugs for 480-volt, 3 phase, 4 wire, 60 cycle entrance. Breakers noted on the drawings to be 100% rated shall be as such. When main breaker is the disconnecting means for a structure, breaker shall be service entrance rated.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Provide motor control equipment in accordance with manufacturer's instructions and drawings.
- B. Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.
- C. 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. If power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current due to improved power factor.
- D. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.

- E. Wireways in motor control centers shall be used only for routing of conductors. Splices are not allowed within wireways.
- F. All wiring within motor control centers shall be landed on terminals inside buckets or equipment compartments, and not left un-terminated within wireways. This shall include all internal MCC wiring and external field wiring, including spare wires.
- G. 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.
- H. Control wiring and field wiring (120V and below) within MCCs shall be separated from power wiring (277V and above). Where possible, route control and field wiring in separate raceways or wireways. Provide a minimum of 2 inches separation between control wiring, field wiring, and power wiring.
- I. All motors will be provided by other divisions, ready for connections. This contractor shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.
- J. 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.
- K. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits, as specified in Section 16120-Wire.
- L. Provide motor starters as specified for all motors, unless shown or specified that starters or control equipment will be furnished by others.
- M. 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 16500

### LIGHTING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes a complete functional lighting system.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the “UL” label where practicable. In all cases the lighting fixtures shall be constructed with “UL” listed components.
- B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.

##### 1.03 SYSTEM DESCRIPTION

- A. Intent: It is the intent of these specifications to obtain a completed lighting fixture installation by CONTRACTOR. Completed means lamped, cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.
- B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features, accessories, and options specified, scheduled or required, are to be included for all fixtures provided.
- C. Provide lamps for all fixtures of size and type as recommended by the fixture manufacturer and as scheduled.

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals. Shop drawings shall include, but not be limited to, the following:

1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, pre-finishes, metal thickness, fabrication methods, support method, ballasts, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents. Manufacturers' catalog cut sheets will not be acceptable.
  2. Installation instructions.
  3. Certified test data and reports.
  4. Shop drawings shall not only clearly indicate the assigned fixture type but also the equipment location.
  5. Provide a submittal on all lamp types used. Submittal should include but not be limited to, lumen output, lamp color temperature, and CRI value.
- B. Submit for review samples requested by ENGINEER. The fixtures or components are to be tagged with the project name and the fixture type. Samples will be held by CONTRACTOR available for reference throughout the construction period. Fixtures or components under the contract shall be identical with the accepted samples. No sample (fixture or component) is to be installed on the Project.
1. In the event the submissions are not approved, the materials will be returned to CONTRACTOR to immediately make a new submission responding to the notations (corrections/revisions) of ENGINEER regarding compliance with the Contract Documents.
  2. All charges for these shipments shall be paid by CONTRACTOR.
  3. The fixture schedule shows the style of the fixture only. CONTRACTOR shall verify the types of ceiling and mounting construction prior to releasing fixtures for fabrication and delivery and provide fixtures adapted to the ceiling construction used.

#### 1.05 QUALITY ASSURANCE

- A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.
- B. Warranties: CONTRACTOR shall warrant all work under this section to be free from defects in materials and workmanship for a period of one year after substantial completion. CONTRACTOR shall secure and provide to OWNER manufacturer's warranties for ballasts and other such component items.
- C. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.
- D. Photometric Testing: Samples may be necessary to be subjected to photometric testing at the request of ENGINEER. Luminaire efficiency shall be determined in an integrating sphere not less than 100 inches in diameter. Testing will be at CONTRACTOR's expense.
- E. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.

- F. 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.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices, lamps, and components necessary for the proper operation of the equipment.
- B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.
- C. Timely Purchasing: Luminaires and associated lamps and other allied equipment shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

### PART 2-PRODUCTS

#### 2.01 FABRICATION

- A. Materials: Provide dimensional thickness of metal, plastic, and composite materials so that all fixtures are rigid, stable, and will resist deflection, twisting, and warping under normal installation and relamping procedures.
  - 1. All luminaire housings shall be minimum 22 gauge cold rolled steel, unless a heavier gauge is specified.
  - 2. All aluminum extrusion housings shall be minimum 3/16-inch-thick.
  - 3. All spun, hydroformed, or sheet aluminum reflectors shall be fabricated from #12 aluminum sheets minimum, 15 gauge (0.57-inch) or heavier.
  - 4. All acrylic and polycarbonate lenses and/or diffusers shall be minimum 1/8-inch nominal thickness.
- B. Joints: Provide positive, durable, means of connection at all joints. NO HOLLOW RIVETS shall be used.
- C. Gaskets: Provide neoprene, silicone, rubber, or other appropriate gasketing, stops, and barriers where required to prevent light leak, control sound and vibration, prevent water leaks, and if pertinent, water vapor penetration.
- D. Edges: Provide finished product with the following minimum qualities:
  - 1. Ground and/or burr-free metal edges.
  - 2. Tight fitting connections, hinges, and closures.
  - 3. Clean neat corners, edges, trims, and frames.
- E. Castings: All cast parts, including die-cast members, shall be of uniform quality; free from blow holes, pores, hard spots, shrinkage defects, cracks, or other imperfections that affect strength and appearance or are indicative of inferior metals or alloys.

2.02 FINISHES

- A. Application: Fixture finishes shall be applied in a manner that will assure a durable wear-resistant surface:
  - 1. Prior to finishing, all surfaces must be free from foreign materials such as dirt, rust, oil, polishing compounds, and mold release agents.
  - 2. All castings and extrusions shall be machined, sanded, or similarly treated and given minimum one coat of baked-on clear methacrylate lacquer, unless a painted finish is specified.
  - 3. Aluminum surfaces exposed to weather (other than anodized reflectors covered elsewhere) shall receive a duromodic or polyester powder paint finish as specified for corrosion resistance.
  - 4. Sheet steel fixture housings, iron and steel parts, which have not received phosphating treatment (“Bonderizing” or similar process) or are to be utilized in exterior applications, are to be made corrosion resistant by zinc or cadmium plating or hot-dip galvanizing.
  - 5. Unless specified to the contrary, all fluorescent fixture housings shall have a complete coverage of white alkyd reflecting enamel, 85% minimum reflectivity, applied by either a spray or dip process, then baked in a temperature controlled oven until paint is thoroughly cured. Prior to applying the enamel, each metallic surface shall be prepared for painting by using a five-stage hot zinc phosphatizing process.
  - 6. Plastic refractors diffusers material shall be light-stable 100% virgin acrylic, translucent (98% minimum transmission), unless specified otherwise, conforming to minimum standards of IES-NEMA-SPI. Material shall perform as applied in a normal interior environment for a period of 20 years without noticeable deformation and with a transmission loss not exceeding 5%. Nominal thickness of material shall be 0.125-inch for either extrusions or injections.

2.03 LAMPS

- A. Lamps: Provide new lamps as specified for all lighting fixtures (luminaires) as shown on the drawings.
- B. Fluorescent Lamps:
  - 1. All fluorescent lamps shall be of the same manufacturer.
  - 2. All fluorescent lamps shall be 3500 K color temperature.
  - 3. Color Rendering Index (CRI).
    - a. Linear fluorescent lamps shall have a minimum CRI rating of 86.
  - 4. Lamps shall be of the wattage specified on the drawings.
  - 5. Initial lamp lumen output shall be as follows:

Lamp Type	Nominal Wattage	Minimum Initial Lamp Lumens
T8	32	3000

- C. Lamps shall be manufactured by Phillips, Sylvania Osram, or equal, wattage as indicated on the drawings.
- D. LED Sources:
  - 1. All LED sources shall be of the same manufacturer.
  - 2. All LED sources shall be as shown on drawings.
  - 3. All LED sources shall have a minimum CRI rating of 70.

4. All LED sources shall be of the wattage specified on the drawings.
5. Initial LED source lumens shall be as shown on drawings.

#### 2.04 LAMP HOLDERS

- A. Screw Base: Screw base sockets for incandescent and metal halide lamps shall be of heavy-duty heat-resistant porcelain with spring center contacts and plated screw shells.
- B. Fluorescent Sockets: Fluorescent lamp sockets operating with an open circuit voltage in excess of 300 volts shall be of the safety-type that open the supply circuit when the lamp is removed from the sockets.
- C. All fluorescent fixtures installed that have no glass or metal enclosure shall be equipped with safety-type lamp holders so that lamps shall not become dislodged from the holders.

#### 2.05 WIRING

- A. Minimum Standards: All wiring shall comply with the following standards.
  1. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 16120–Wire.
  2. Wiring between fluorescent lamp holders and associated operating and starting equipment shall be of similar or heavier gauge than the leads furnished with the ballasts.
  3. Wire leads to the receptacle or connector of any side prong incandescent lamp, or any “cool-beam” lamp, or any lamp 200 watts or over shall be SF-2 (silicone rubber insulated) stranded wire.
  4. Wiring within fixture construction is to be concealed, except where the fixture design or mounting dictates otherwise.
  5. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
  6. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

#### 2.06 LAMP BALLASTS

- A. Linear Fluorescent Electronic Ballast:
  1. Fluorescent Ballast: Shall meet UL Standard 935. Ballasts shall be PROGRAM RAPID START (PRS) type.
  2. Ballasts shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The input current 3rd harmonic content shall not exceed 13% of the input current. The total harmonic distortion shall not exceed 10%.
  3. Fluorescent ballasts shall conform to the performance criteria listed below:

Ballast	Nominal Lamp Watts	Max. Input Watts (ANSI)	Minimum Ballast Factor
1-F32T8	32	28	0.84-0.87
2-F32T8	32	56	0.84-0.87
3-F32T8	32	84	0.84-0.87
All others			0.84-0.87

4. Luminaires designed as multi-level switching shall have a combination of 1, 2, or 3 lamp ballasts configured to allow switching of all inboard lamps as a group separate from outboard lamps in the room. Master/slave luminaire arrangement is acceptable. CONTRACTOR shall verify ballast configuration to achieve switching shown prior to submittal.
  5. Ballasts shall be universal voltage. The ballast must maintain constant high output through the entire input voltage ranges of 120 volt to 277 volt.
  6. Ballast Requirements:
    - a. Current crest factor shall be no greater than 1.7.
    - b. The operating ambient temperature range shall be 50°F to 105°F.
    - c. Fluorescent ballasts shall operate at 20 kHz or higher, with no detectable lamp flicker.
    - d. Four lamp ballasts shall operate parallel circuit lamps that allow remaining lamps to maintain full output if companion lamps fail.
    - e. Ballasts shall not be affected by lamp failure and shall yield normal lamp life.
    - f. Ballast power factor shall be greater than 95%.
    - g. Ballast shall be rated Class P, thermally protected and have a Class A sound rating, or better.
    - h. Ballast shall comply with EMI and RFI limits set by FCC (CFR 47 Part 18).
    - i. Ballasts shall carry a three-year warranty including labor allowance.
    - j. Program rapid start ballasts shall heat the filament prior to applying the starting voltage to the lamp, then remove lamp cathode heat.
    - k. Cold weather ballast(s) must reliably start and operate lamps in ambient temperatures down to 0°F for the rated life of the lamps.
    - l. Ballasts shall be provided with disconnects. Disconnects shall disconnect all ballast wiring including Hot, Neutral, and Ground conductors. Disconnect shall be UL Listed.
- B. Acceptable Manufacturers: Ballasts made by the following manufacturers will be accepted:
1. General Electric.
  2. Universal.
  3. Advance.
  4. Motorola/Osram.

## 2.07 MARKING OF FIXTURES

- A. Voltage Identification: Fixtures designed for voltages other than 110 to 125 volts circuits shall be clearly marked.
- B. Lamp Types: Fixtures equipped with ballasts, etc., for operation of rapid start lamps shall be plainly marked "Use Rapid Start Lamps Only." Similarly, fixtures equipped with ballasts, etc., for operation of instant start or other type lamps shall be plainly marked. Markings must be clear and shall be located to be readily visible to service personnel but invisible from normal viewing angles when lamps are in place.

## 2.08 FIXTURE TRIMS

- A. Trim Details: Provide trim details as shown on the drawings or as specified. The trim finish and dimensions are subject to the shop drawing approval of ENGINEER.
  1. Mitered corners shall be smoothed before shop finish is applied. No lapping of trim metal for all flush mounted ceiling trims for rectangular or square recessed fixtures.

2. All exposed ceiling trim and inside reveals on all fixtures shall be painted in a color to match ENGINEER's sample.

## 2.09 EMERGENCY LIGHTING UNINTERRUPTIBLE POWER SUPPLIES (UPS)

- A. UPS input shall be 120/277 VAC, 60Hz, three wire (Switched Hot, Common, Unswitched Hot) plus ground. Input shall be protected by circuit breaker sized for UPS load.
- B. UPS output shall be 120/277 VAC, 60Hz, two wire plus ground, suitable for use with HID, fluorescent, LED, and incandescent fixtures. Output shall be protected by circuit breaker sized for UPS load.
- C. UPS battery shall be sealed lead calcium. Battery shall be sized appropriately to provide 90 minutes of runtime for 100% of rated output VA.
- D. UPS shall be rated for use in ambient conditions of 68°F to 86°F.
- E. UPS volt-ampere (VA) output rating shall be 100 VA or 250 VA as required for loads indicated on drawings.
- F. UPS shall be equipped with self-diagnostic circuitry. Circuitry shall check different operating parameters during initial start-up, normal standby, and diagnostic stages. If a fault is detected, the fault indicator shall flash to alert maintenance personnel.
- G. UPS shall automatically initiate a 15-minute diagnostic cycle every 25 to 30 days to test emergency operation. The self-diagnostic circuitry shall not utilize the lighting load (i.e. the emergency lamps) to cycle and test the unit battery. Instead, a built-in resistive load shall be used, thereby eliminating emergency lamp illumination during diagnostic testing.
- H. UPS shall be capable of providing emergency illumination to switched and unswitched lamps. UPS shall monitor the reference voltage from the line (unswitched) side of the control device. In the event the reference voltage is lost the UPS shall power the connected lamps regardless of control device position.
- I. UPS shall be capable of being mounted a maximum of 1000 FT from the emergency fixtures.
- J. UPS shall be UL 924 listed and meet NFPA 101 requirements.
- K. Inverter module and battery module shall be housed in a NEMA 1 enclosure.
- L. Three year warranty on all UPS components shall be included.
- M. UPS shall be Mini Inverter Model ELI-100-SD or ELI-250-SD as manufactured by Bodine, or equal.

## PART 3-EXECUTION

### 3.01 LIGHTING CONTROLS

- A. Complex Occupancy: Dual ballast fixtures shall be controlled with occupancy sensors in conjunction with wall switch(es).
  - 1. The wall switch(es) shall control the respective ballast(s) as designated on the drawings.
  - 2. With the switch in the "On" position, control shall be through the occupancy sensor such that if the sensor is activated the ballast(s) shall be energized.
  - 3. If the wall switch(es) is in the "Off" position, the fixture shall be de-energized.

### 3.02 INSTALLATION

- A. Install fixtures, lamps, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All lamps, glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
- B. Lamps installed for use as temporary lighting shall be replaced with new lamps.
- C. All wall mounted fixtures and all ceiling mounted surface fixtures including exit lights shall be fed through a fixture Stud/Hickey/Nipple assembly and with provisions to prevent fixture turning.
- D. All fixtures shall be securely and adequately supported and installed.
- E. Surface or pendant mounted fixtures shall be attached to and supported from structural part of the building in a manner acceptable to ENGINEER. Fluorescent fixtures shall be supported by not less than two supports for each fixture. Where fluorescent fixtures are to be suspended, they shall be mounted on steel channel with the channel supported directly to the structure by a minimum of 3/8-inch rod inside rigid conduit stems. Any fixture which has an individual fixture weight of greater than 25 pounds shall have safety cable installed in addition to other support means. Cable shall be 3/16-inch airplane cable. All fittings and connectors shall be compression-type. Cables must be secured to the building structure and to a point or points on the fixture to ensure against falling parts.
- F. Industrial-type fixtures in unfinished areas which are near obstructions such as ducts and pipes shall be suspended so that the bottom of the fixture is no higher than the bottom of the obstruction. All fixtures in each room should be located at the height of the lowest fixture but not lower than 8 feet 0 inches A.F.F. Fixtures shall not be located until the locations of these obstructions are determined, and fixtures shall be accessible after installation of other equipment.
- G. Provide inscription for exit to conform to codes.
- H. Metal decking shall not be pierced for fixture support.
- I. All fixture whips shall be constructed of minimum No. 12 AWG conductors.

### 3.03 SUPPORTS

- A. Mounting Frames: Provide mounting frames (plaster frames for example) as necessary for installation and as called for under other sections. Frames are to be finished matte white baked enamel unless otherwise noted.
- B. Mounting Accessories: Fixtures shall be securely attached so there is minimum possible movement up, down, or sideways. Fixtures shall be mounted to permit access to wiring. Fastening devices shall be of a positive, locking-type and will not require the use of special tools to apply or remove. Tie wires shall not be used in place of fastening devices.
- C. Fire Codes: Where necessary to meet Code requirements, enclosure housings shall be constructed to provide a 1-hour fire rating.
- D. CONTRACTOR Responsibility: CONTRACTOR shall verify all ceiling conditions from the drawings and furnish appropriate mounting details for each lighting fixture.
- E. Pendant Mounting: Provide pendant or surface mounted fixtures with required mounting devices and accessories, including hickeys, stud extensions, ball aligners, canopies, and stems. Coordinate locations of fixtures in mechanical areas. Provide mounting stems on pendant fixtures of the correct length to uniformly maintain the fixture heights shown on the drawings or established in the field.
- F. Adequate, rigid, sturdy support shall be provided to prevent possibility of fixture falling. Surface and pendant fluorescent fixtures must be supported with two supports per 4-foot section, except that continuous 8-foot chassis shall have three supports. All pendants must have swivel aligners located at the top ends; pendants shall be minimum 3/8-inch threaded rod inside 3/4-inch rigid steel conduit, unless specifically indicated otherwise on the drawings, painted on job site. Support surface mounted fluorescent fixtures from structural members other than ceiling tees by providing Unistrut members laid across main ceiling tees or by attachment directly to structure.

### 3.04 ADJUSTMENT

- A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring (both interior and exterior units) shall be adjusted after dark under supervision of OWNER.

### 3.05 CLEANING

- A. Installation Sequence: Lighting fixture mounting frames, plaster rings, etc., are required to be installed prior to the finishing assembly which shall not be installed until the Project is "broom clean." When the fixture location or construction cannot permit sequential installation, CONTRACTOR shall carefully protect all reflectors, lenses, flanges, and other visible surfaces.
- B. Cleaning: Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

### 3.06 FINAL INSPECTION

- A. Upon completion of the installation, lighting equipment must be in first class operating order and free from defects in condition and finish:
1. At time of final inspection, all fixtures and equipment must be installed and lamped with new lamps and be complete with all lenses, diffusers, reflectors, side panels, louvers, or other necessary components.
  2. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
  3. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection shall be replaced at no expense to OWNER.
  4. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

## SECTION 16723

### FIRE ALARM SYSTEM

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes the furnishing of all labor, equipment, materials, and performance of all operations associated with the installation of the Fire Alarm System as shown on the drawings and as specified herein to meet the requirements of a complete Fire Alarm System.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 REFERENCES

- A. NFPA 72, the National Fire Alarm Code.
- B. ADA.
- C. Underwriters Laboratories.

##### 1.03 SCOPE

- A. Furnish and install a complete Fire Alarm System to be wired, connected, and left in first class operating condition. The system shall be UL Listed, crosslisted, and compatible for use with closed loop initiating device circuits with individual zone supervision, individual NAC supervision, and incoming and standby power supervision. The project includes furnishing a system which includes manual stations, smoke detectors, audible/visual devices, visual only devices, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.
- B. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the installation of the Fire Alarm System as shown on the drawings and as herein specified.

##### 1.04 QUALITY ASSURANCE

- A. System Supplier shall be a nationally recognized company specializing in smoke detection and fire alarm systems. This organization shall employ factory trained and NICET certified technicians, and shall maintain a service organization within 100 miles of this project location. The System Supplier and service organization shall have a minimum of 10 years experience in the fire protective signaling systems industry.
- B. The System Supplier shall supply the final check-out, contractual service and testing.
- C. The complete installation is to conform to the applicable sections of NFPA-72, NFPA-101a Local Code Requirements and National Electrical Code with particular attention to Article 760.

- D. Each and all items of the complete Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer unless the primary equipment provider or manufacturer provides written documentation of compatibility and assumes responsibility for compatibility with the control equipment.
- E. Each and all items of the complete Fire Alarm System shall be listed under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the UL label.

#### 1.05 SUBMITTALS

- A. Submit shop drawings and product data sheets in accordance with provisions of Section 01300-Submittals.
- B. Provide wiring diagrams, equipment ratings, dimensions, and finishes for all proposed devices and equipment.
- C. Provide battery calculations to indicate both the Standby and Alarm loads, due to various field devices and panel components/module. Battery calculations shall illustrate the minimum battery capacity required and the capacity actually provided.
- D. Provide a complete Fire Alarm System riser diagram including: point of origin of each circuit (usually a Panel, or a Module within a panel), circuit type and labeling, area served by each circuit, wire/cable type and size, locations of panelboards where primary system power is obtained and the device type, circuit(s) to which device is connected, locations of any End-Of-Line Resistor for each field device.
- E. Provide "worst case" notification appliance circuit voltage drop calculation.

#### 1.06 AS-BUILT DRAWINGS

- A. Record drawings shall include the location of all Fire Alarm System devices with their respective labels and the location of all end-of-line device locations.
- B. Upon completion of the work, and final acceptance by the local authority, CONTRACTOR shall submit record drawings to OWNER and ENGINEER under the provisions of Division 1.
- C. CONTRACTOR shall submit a copy of the Fire Alarm System; Record of Completion documentation to OWNER, ENGINEER, and AUTHORITY HAVING JURISDICTION. Included with the Record of Completion documentation shall be a copy of final acceptance testing results.

#### 1.07 OPERATION AND MAINTENANCE DATA

- A. Submit Manufacturer data sheets for all equipment installed.
- B. Include operating, installation, and routine maintenance instructions.
- C. Submit a record copy of site-specific computer software for software-based Fire Alarm Systems.

- D. Include manufacturer letter stating the date of installation on which the system is operational.

## PART 2--PRODUCTS

### 2.01 SYSTEM DESCRIPTION

- A. Fire Alarm System: Provide a complete, supervised, power-limited, fire detection, and evacuation system.
- B. System Supervision: The fire protective signaling system shall be an electrically supervised, power limited system which shall monitor the integrity of circuit conductors and power supplies. Fire alarm system shall be remotely supervised by an OWNER-designated recognized agency. CONTRACTOR shall coordinate with OWNER to establish a monitoring agency.
- C. Equipment of another manufacturer may be submitted as an alternate, however, the contractor must provide a complete system.

### 2.02 ENCLOSURES

- A. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.
- B. Provide cabinets of sufficient size to accommodate the aforementioned equipment.
- C. Cabinet shall be equipped with locks and transparent door panel providing tamper-proof enclosure yet allowing full view of the various lights and controls as required.

### 2.03 MULTIPLEX/INTELLIGENT FIRE ALARM CONTROL PANEL (FACP)

- A. Multiplex intelligent fire alarm systems shall be installed where shown on the drawings.
- B. The FACP shall allow for loading or editing special instructions and operating sequences as required. The system is to be capable of on-site programming to accommodate facility expansion, building parameter changes, or changes as required by local codes. All software operations are to be stored in a nonvolatile, programmable memory resident within the FACP. Loss of power shall not erase the instructions stored in memory.
- C. The ability for selective input/output control functions based on ANDing, ORing, NOTing, and special coded operations is to also be incorporated in the resident software programming of the system.
- D. To accommodate and facilitate job site changes, initiation circuits shall be individually configurable on-site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a nonlatching circuit, or an alarm verification circuit.
- E. FACP shall be modular, expandable with solidstate, microprocessor-based electronics. It shall display through the front viewing window only those primary controls and displays essential to operation during a fire alarm condition.

- F. The FACP shall provide the following features as standards:
1. Support intelligent detection devices.
  2. The number of initiating device loops required for the specified quantity of initiating devices, plus one spare loop for each five active loops. Each active loop shall include 5% spare capacity.
  3. The number of indicating appliance (speakers) circuits required for the specified quantity speakers, plus one spare circuit for each ten active circuits. Each active circuit shall include 25% spare capacity.
  4. The number of indicating appliance (strobe) circuits required for the specified quantity of strobes, plus one spare circuit for each ten active circuits. Each active circuit shall include 25% spare capacity.
  5. 80-character liquid crystal display.
  6. Printer interface.
  7. History log file with a minimum of 400 events.
  8. Field programmable.
  9. Drift compensation.
  10. Sensitivity display in %.
  11. Sensitivity adjustment.
  12. Day/night sensitivity adjustment.
  13. Auto detector test to meet NFPA 72.
  14. Alarm verification with tally counter.
  15. Silent walk test.
  16. Maintenance alerts.
  17. AC fail delay.
  18. Other features as described below.
- G. The FACP shall provide the ability to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history.
- H. The FACP LCD shall have the capability of displaying the following information relative to the abnormal condition of a point in the system prior to acknowledgement:
1. 40 characters for:
    - a. Point address and loop number (i.e., 555-L5).
    - b. Type of device (i.e., smoke, pull station, water-flow).
    - c. Point status (i.e., alarm, trouble).
  2. 40 characters for: Custom location label (i.e., 4th Floor–Room 444).
- I. FACP keyboards or keypads shall not be required to operate the system during fire alarm conditions.
- J. FACP shall have the following software functions:
1. Setting of time and date.
  2. LED testing.
  3. Alarm, trouble, and abnormal condition listing.
  4. Enabling and disabling of each monitor point separately.
  5. Activation and deactivation of each control point separately.
  6. Changing operator access levels.
  7. Walk Test enable.
  8. Running diagnostic functions.
  9. Displaying historical logs.
  10. Point listing.

- K. FACP shall have the following hardware functions:
1. Acknowledge alarm or trouble.
  2. Silence alarm or trouble.
  3. Reset system after alarm.
  4. Connect/disconnect fire department tie.
  5. Provide manual evacuation (drill).
  6. Bypass door holders.
  7. Supervise system.
  8. Allow computer interface.
- L. FACP shall have the following Status Indicators and Displays:
1. Local audible device shall sound during Alarm, Trouble or Supervisory conditions. This audible device shall also sound during each key-press to provide an audible feedback to ensure that the key has been pressed properly. The visual display shall distinguish between alarm, trouble and supervisory conditions.
  2. The following indicators and displays shall be visible through the front viewing window:
    - a. One red system alarm LED.
    - b. One yellow supervisory service LED.
    - c. One yellow trouble LED.
    - d. Green "power on" LED.
    - e. Eighty-character liquid crystal display.
  3. The 2-line by 40-character liquid crystal display shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
  4. The display shall support both upper and lowercase letters. Lowercase letters shall be used for soft-key titles and prompting the user. Uppercase letters shall be used for system status information. A cursor shall be visible when entering information.
  5. Scrolling through menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct the user. These controls shall be located behind an access door. The following status data shall be available on this display:
    - a. Initiating device circuits.
    - b. Indicating appliance circuits.
    - c. Auxiliary relays.
    - d. Feedback points.
    - e. Primary state of point.
    - f. Zone information.
    - g. Class "A" status.
    - h. Current priority of outputs.
    - i. Disable/Enable status.
    - j. Verification tallies of initiating devices.
    - k. Automatic/Manual control status of output points.
    - l. Acknowledge status.
- M. Controls:
1. The following controls (one switch per function per system) shall be visible through the front viewing window.
    - a. Alarm Acknowledge key.
    - b. Trouble Acknowledge key.
    - c. Alarm Silence key.
    - d. System Reset key.

2. The following controls shall be accessible with the front door open, though not visible through the front viewing window:
    - a. Supervising Station disconnect/switch.
    - b. Manual evacuation (drill).
    - c. Elevator bypass.
    - d. Fan shutdown override/bypass switches.
    - e. Door holder release bypass.
    - f. Key pad for data input and microprocessor control.
- N. FACP shall have the capability of supervising all slave modules LEDs for burnout or disarrangement.
- O. Acknowledgement:
1. Two methods of acknowledgment for each abnormal condition shall be provided. One may be chosen depending on the NFPA requirements.
  2. Acknowledge one event at a time from an unacknowledged list of events.
  3. Pressing the appropriate acknowledge button shall display the first unacknowledged condition in the appropriate list (either alarm, supervisory, or trouble) and require another acknowledge button. Press to acknowledge only the displayed point.
  4. After all points have been acknowledged, the LEDs shall glow steadily and the Sonalert will be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated by an end of list message "END of LIST."
  5. Systems not capable of password protected manual command operations shall provide key operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.
  6. All acknowledge functions shall be behind locked door or pass-code protected. In pass-code protection; if the user has insufficient privilege to acknowledge such conditions, a message shall indicate insufficient privilege but allow the user to view the points without acknowledging them. Should the user have sufficient privilege to acknowledge, a message will be displayed informing the user that the condition has been acknowledged.
- P. Silencing:
1. If an alarm condition exists and the "Alarm Silence" button is pressed, all alarm signals shall cease operation. The strobes shall remain active until the system is reset.
  2. If trouble conditions exist in the system and the "Trouble Silence" button has been pressed, the aural trouble signal shall cease, but shall resound at time intervals to act as a reminder that the fire alarm system is not in a normal operating mode. Both the time interval and the trouble reminder signal shall be programmable to suit OWNER's application.
  3. Panel shall be equipped with an alarm silence inhibit function.
- Q. Reset:
1. The SYSTEM RESET button shall be used to return the system to its normal state after an alarm condition has been remedied. The display shall step the user through the reset process with simple English language messages. Messages shall provide operator assurance of sequential steps (i.e., "IN PROGRESS," RESET COMPLETED," and "SYSTEM NORMAL) as they occur, should all alarms conditions be cleared.
  2. Should an alarm condition continue to exist, the system shall provide indications that resetting cannot be completed and shall remain in an abnormal state. The Sonalert

and the Alarm LED shall remain activated. The display shall indicate the total number of alarms and troubles present in the system along with a prompt to use the ACK keys to review the points. These points shall not require acknowledgment if they were previously acknowledged.

R. Access Levels:

1. There shall be three access levels with level 4 being the highest level. Level 1 actions shall not require a pass-code. Pass-codes shall consist of up to five digits. Changes to pass-codes shall only be made by authorized personnel.
2. In order to maintain security when entering a pass-code, the digits entered shall not be displayed, but a cursor shall move along filling the position with an X to indicate that the digit has been accepted. All key presses shall be acknowledged by a local audible sound.
3. When a correct pass-code is entered, the system shall indicate "Access Granted" to the operator. The new access level shall be in effect until the operator manually logs out or the keypad has been inactive for 5 minutes.
4. Operator entering an invalid code shall be notified with the message "Incorrect Pass-Code" and shall be allowed up to three chances to enter a valid code. After three unsuccessful tries, the message "Access Denied" shall be displayed. The level shall not be altered, and the operator shall no longer be in the menu option.
5. Access to a level shall allow the operator to perform all actions within that level plus all actions of lower levels but no actions of higher levels.
6. The following keys/switches shall have access levels associated with them:
  - a. Alarm Silence.
  - b. System Reset.
  - c. Set Time/Date.
  - d. Manual Control.
  - e. On/Off/Auto Control.
  - f. Disable/Enable.
  - g. Programming functions.
  - h. Clear Historical Alarm Log.
  - i. Clear Historical Trouble Log.
  - j. Walk Test.
  - k. Change Alarm Verification.
7. Acknowledge keys shall also require privileged access to acknowledge points. If the operator presses an ACK key with insufficient access, an error message shall be displayed. The points shall scroll with ACK key presses to view the points on the list, but the points shall not get acknowledged in the database.

S. For maintenance purposes, the following lists shall be available from the point lists menu:

1. All points list by address.
2. Monitor point list.
3. Signal/speaker list.
4. Auxiliary control list.
5. Feedback point list.

T. History Logging:

1. The system shall be capable of logging and storing the last 400 events (alarm and trouble) in a history log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence. Systems not having discrete alarm and trouble logging memory shall include an alternative supervised (e.g., USB drive, compact disk) historic recording

- method with battery backup. Real time and date shall accompany all history event recording.
2. History logs shall be capable of being viewed separately or shall be selectable for viewing as a combined history log that displays both alarm and trouble events in chronological order.
  3. The following historical alarm log events shall be stored:
    - a. Alarms.
    - b. Alarm Acknowledgment.
    - c. Alarm Silence.
    - d. System Reset.
    - e. Alarm Historical log cleared.
  4. The following historical trouble log events shall be stored:
    - a. Trouble conditions.
    - b. Supervisory alarms.
    - c. Trouble acknowledgment.
    - d. Supervisory acknowledgment.
    - e. Alarm Verification tallies.
    - f. Walk Test results.
    - g. Trouble Historical log cleared.
- U. FACP shall have Silent Walk Test Function With History Logging:
1. The system shall be capable of being tested by one person.
  2. The panel shall have the capability of dividing the system into distinctive walk test groups, a minimum of 8 groups.
  3. Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations described above.
  4. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.
  5. Suppliers of systems not having this feature as functionally specified above shall include a testing agreement meeting the requirements of NFPA-72 in their base bid quotation. As a minimum, 2 years of scheduled testing shall be included.
- V. Computer Interface:
1. The FACP shall operate as a proprietary local system with the capability of sending status data to and receiving control data from a Central Processing Unit (CPU) at the central reporting stations.
  2. The CPU would monitor all alarms and troubles and would control selected functions of each FACP.
  3. The CPU shall supervise all data communication wiring between the CPU and FACP for opens, shorts, and grounds.
- W. Field Programming:
1. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory ICs. All programming may be accomplished through the standard control panel keyboard, or a keyboard at the printer, or the use of a PC. All programs shall be stored in nonvolatile memory.
  2. All programming or reprogramming shall be done by the supplier at no charge until the system is accepted by OWNER.

- X. Terminal/Printer Interface:
  - 1. FACP shall be capable of operating remote monitors and/or printers.
  - 2. The output shall be ASCII from an EIA RS-232-C connection with an adjustable baud rate.
  - 3. Each RS-232-C port shall be capable of supporting and supervising up to 4 remote CRTs and Printers.
  - 4. Data amplifiers shall be used to increase CRT or printer line distance, if required.
  - 5. Each RS-232-C port shall only communicate with one keyboard. The FACP shall support up to five RS-232-C ports.
  
- Y. Intelligent Network:
  - 1. The system must provide communications with intelligent initiating and control devices individually. These devices shall be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
    - a. Alarm.
    - b. Trouble.
    - c. Open.
    - d. Short.
    - e. Device missing/failed.
  - 2. All intelligent devices shall have the capability of being disabled or enabled individually.
  - 3. There shall be no limit to the number of detectors, stations, or addressable modules which may be activated or "in alarm" simultaneously.
  - 4. Multiple intelligent devices shall be connected to a single pair of wires. Systems that require factory pre-programming to add or delete devices are unacceptable.
  - 5. The communication format must be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol. Systems that do not utilize full digital transmission protocol are not acceptable.
  
- Z. The FACP shall provide a minimum of 4 amps for notification appliances and auxiliary devices. Provisions shall be available to provide additional signal expansion. Provide auxiliary contacts for fire system trouble, fire system alarm and fire system supervisory service for monitoring at the SCADA system.

## 2.04 MULTIPLEX/INTELLIGENT PERIPHERAL DEVICES

- A. All devices shall be supervised for trouble conditions. The system control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Failure of a device shall not hinder the operation of other system devices.

## 2.05 DEVICE IDENTIFICATION

- A. Each intelligent device shall be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address shall not be acceptable. This address along with the loop number shall be indicated, and be visible from the ground, on the device in the field using machine generated marking.
- B. Location of the end-of-line (EOL) device shall be indicated on the fire alarm system device containing the EOL device.

- C. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate t-tapping, and the addition of an intelligent device between existing devices requires reprogramming all existing devices beyond added device.
- D. The system must verify that proper type device is in place and matches the desired software configuration.

## 2.06 INTELLIGENT DETECTOR BASES

- A. Either the base or the head shall contain electronic circuits that communicate the detector's status (normal, alarm, sensitivity status, trouble, etc.) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Contacts between the base and head shall be of the bifurcated-type using spring-type, self-wiping contacts.
- B. The base shall be lockable. The locking feature must be field-removable when not required.
- C. Upon removal of the detector's head, a trouble signal shall be transmitted to the control panel.
- D. The detector base shall be sealed against rear airflow entry.
- E. Each detector's base or head shall contain LED(s) which shall flash when the detector is being scanned by the control panel. The LED(s) shall turn on steady when the detector is in an alarm condition.
- F. Each base shall provide means to allow for function testing of the detector at the detector's location.
- G. The base shall be common with heat detector and smoke-type detectors and shall be compatible with other intelligent detectors, addressable manual stations, and addressable modules on the same circuit.

## 2.07 INTELLIGENT DETECTORS – GENERAL

- A. All detectors must be approved by the State Engineer prior to installation.
- B. The detectors shall be plug-in units, which mount to a common base, and shall be UL 268 approved.
- C. The detector shall be a 24VDC type, which is compatible with the fire alarm panel and obtains its operating power from the supervisory current in the fire alarm detection loop. The 24 VDC detector shall be reset by actuating the control panel reset switch.
- D. To minimize false alarms, voltage and RF transient suppression techniques shall be employed.
- E. Detectors shall be installed on circuits with alarm verification modules.
- F. Detectors shall include an insect screen.

- G. If field conditions so require, the detection devices shall not be installed until construction is completed.

## 2.08 INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

- A. The detectors shall contain no radioactive material.
- B. Detectors shall be of the solid state photoelectric type and shall operate on the light scattering photodiode principle using a pulsed infrared LED light.
- C. Smoke detectors shall be listed for sensitivity testing from the control panel. Sensitivity test results shall be logged.
- D. Smoke detectors shall communicate the actual smoke chamber values to the system control panel.
- E. Smoke detectors shall be smoke density measuring devices having no self-contained alarm setpoint (fixed threshold). The alarm decision for each detector shall be determined by the control panel. The control panel shall determine the condition of each detector by comparing the detector's value to the stored value.

## 2.09 PULL STATIONS

- A. Pull stations shall contain circuits that communicate the station's status (alarm, normal) to the control panel over two wires, which also provide power to the pull station. The address shall be field programmable at the station.
- B. Manual stations shall be double-action, constructed of high-impact red Lexan with raised white lettering, and a smooth high gloss finish.
- C. Station shall mechanically latch upon operation and remain so until manually reset by a master key common to all system locks. Stations which use Allen wrenches or special tools to reset will not be accepted.
- D. The manual station shall be fitted with screw terminals for field wire attachment.

## 2.10 ADDRESSABLE INTERFACE MODULES – GENERAL

- A. Addressable Interface Modules shall receive their 24VDC power from a separate two-wire circuit provided by an appropriate power supply.
- B. The module shall be available in either a Class B or Class A supervision version.
- C. In the Class B version, the wiring shall be supervised by an end-of-line device.
- D. In the Class A version, the wiring shall be looped back and connected to the module to allow continual operation of the controlled devices even if the wiring sustains a single break.

- E. The interface modules shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions.
- F. Should the interface modules become nonoperational, tampered with, or removed, a discrete trouble signal unique to the device shall be transmitted to and annunciated at the control panel.
- G. The interface modules shall be capable of being programmed for its "address" location on the intelligent device initiating circuit. The interface modules shall be compatible with addressable manual stations and intelligent detectors on the same intelligent initiating circuit.

#### 2.11 ADDRESSABLE INTERFACE MODULES—SUPERVISED CONTROL

- A. Interface Modules shall be suited for control of indicating appliances and AHU systems.
- B. For signals, speakers, fire fighter phone jacks, and other device control with Class B or Class A wiring supervision, the interface module shall provide double-pole/double-throw relay switching that can be used to connect any of the following through easily replaceable 2 amp fuses:
  - 1. A zone of signals to a power source.
  - 2. Speakers to an audio source.
  - 3. Fire fighter phone jacks to a communications channel.
  - 4. A variety of controlled devices to the appropriate controlling circuits.
- C. These interface modules shall communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and shall receive from the fire alarm control panel a command to transfer the relay.

#### 2.12 FAULT ISOLATOR MODULE

- A. The system shall have Fault Isolator Module (FIM) on the initiating device circuits in the following situations:
  - 1. Loop extends to another floor.
  - 2. Loop extends to another building.
  - 3. Loop has more than 25 devices.
- B. Isolated Loop Circuit Protectors (ILCP) shall be located as close as practical to the point where these conditions occur.
- C. FIM shall automatically reconnect the isolated section of the loop upon correction of the fault conditions. The FIM shall not require any address setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an FIM after its normal operation.
- D. FIM shall include an LED, which shall flash under normal operation and illuminate steady to indicate a short-circuit.

## 2.13 HORN/STROBE UNITS

- A. Horns shall have Lexan housing with field adjustable output taps, three taps minimum. Sound pressure level output shall be 87 dB at 10 feet. Horns shall have vandal-resistant Lexan grills and sealed backs to protect the phenolic impregnated cone.
- B. The unit shall be complete with a tamper-resistant Lexan lens with "FIRE" lettering visible from a 180° field of view. Strobes installed in open areas such as hallways, open office spaces, and assembly areas shall have an adjustable candela rating range from 15-75 candela. Strobes installed in mechanical areas shall have a peak candela rating of 110 candela. All strobes shall be in compliance with ADA requirements.
- C. Strobe devices installed in NEMA 4X areas shall be installed in a clear Lexan enclosure. Enclosure shall be Model STI 1220 as manufactured by Safety Technology International Inc., or equal.
- D. Horn devices installed in NEMA 4X areas shall be rated at 110 dBA at 10 feet. Horn device shall be model 300GCX as manufactured by Federal Signal Corporation. Horn device shall be powered through the FAS. Provide addressable relay modules and supervisory relays to activate this device from the FACP.

## PART 3-EXECUTION

### 3.01 FIRE ALARM SYSTEM OPERATION

- A. FACP:
  - 1. Under normal condition, the front panel shall display a "SYSTEM NORMAL" message with current time and date.
  - 2. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.
  - 3. In the event of an abnormal condition, the following three characteristics relative to the condition shall be displayed simultaneously in alphanumeric format. Systems not capable of such a display on the panel faceplate shall include a CRT display meeting the above requirements and must provide a secondary power supply to maintain CRT operation for the duration of the standby requirements of the panel. Information shall include:
    - a. Custom location label (40 characters minimum).
    - b. Type of device (i.e., smoke, pull station).
    - c. Status (i.e., alarm, trouble).
  - 4. Pressing the appropriate acknowledge button shall acknowledge the alarm or trouble condition.
  - 5. After all points in alarm have been acknowledged, associated LEDs shall glow steady and the panel audible signal shall be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated. The first 10 fire alarm zones shall be displayed simultaneously in chronological order.
  - 6. Alarm Silencing:
    - a. Pressing the "Alarm Silence" button shall cause all notification appliances programmed for "On-Until-Silenced" to be deactivated. A separate panel-mounted yellow LED shall illuminate to indicate the alarm silenced mode.

- b. All NACs programmed for "On-Until-Reset" shall remain activated until the system is Reset.
- 7. System Reset:
  - a. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied.
  - b. In the event an alarm condition continues to exist following system reset, the system shall remain in an abnormal state. System control relays shall not reset. The panel audible signal and the Alarm LED shall remain on. The display shall indicate the total number of alarms and troubles present in the system along with a prompting to review the points. These points shall not require acknowledgment if they were previously acknowledged.
  - c. In the event the Alarm Silence inhibit function is active, the system shall ignore all Key presses. An indication of enabling and disabling the inhibit stator shall be provided as a feedback to the operation.
- 8. Walk Test System Testing:
  - a. While in the test mode, the system shall display a trouble condition.
    - (1) While in the walk test mode, the activation of an initiating device shall be silently logged as an alarm in the historical log. The panel shall automatically reset after logging the alarm.
    - (2) The momentary disconnection of an initiating device or notification appliance shall be silently logged as a trouble condition in the historical log. The panel shall automatically reset itself after logging of the trouble condition.
    - (3) Integrity of the installation conductors of IDCs and NACs shall be verified by momentarily opening any circuit.
    - (4) Walk Test of ground fault circuit testing shall be verified by operating the Notification Appliances for 4 seconds.
  - b. As an option, the Walk Test sequence shall have the capability of activating NACs to signal with a code associated with the alarmed zone. If this option is selected, any momentary opening of initiating or NAC wiring shall cause the notification appliances to sound for 4 seconds to indicate the trouble condition. The Walk Test feature shall automatically revert to the normal operating mode after 8 hours if it is not manually activated.
- 9. LED Supervision: All slave module LEDs shall be supervised for burnout or disarrangement. Should a problem occur, the panel shall display the module and the LED location numbers to facilitate location of that LED.
- 10. Active Status Reminder: Should any Alarm, Supervisory, or Trouble condition be present within the system and the audible signal silenced, the local tone alert shall resound every 8 hours as a reminder that the fire alarm system is not 100% operational.
- 11. Access Levels:
  - a. There shall be a minimum of four access levels. Passcodes shall consist of up to four digits. Changes to passcodes shall be only by authorized personnel. Systems not capable of password protected manual command operations shall provide key operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.
  - b. In order to maintain security when entering a passcode, the entered digits shall not be displayed.
  - c. When a correct passcode is entered, a message indicating acceptance shall be displayed. The new access level shall be in effect until the operator manually logs out or leaves the keypad inactive for 10 minutes.
  - d. When an incorrect passcode is entered, a message shall be displayed indicating that the passcode was invalid.

- e. Access to a level shall only allow the operator to perform all actions within that level and all actions of lower levels, not higher levels.
- f. The following keys/switches shall have access levels associated with them: Alarm Acknowledge–Supervisory Acknowledge–Trouble Acknowledge–Alarm Silence–System Reset.

B. Smoke Detection Operation:

1. The activation of any system smoke shall initiate an alarm verification operation whereby the FACP will reset the activated detector and wait for a second alarm activation. If after 20 seconds and within one minute after resetting a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute, the system shall resume normal operation. The alarm verification shall operate only on single smoke alarm. Other activated initiating devices or multiple smoke or heat detector alarms shall be processed and reported immediately. The alarm verification operation shall be selectable by device or zone.
2. The multiplex/intelligent system shall have the capability of displaying the number of times (tally) a detector has gone into a verification mode.
3. Smoke detectors shall be smoke density measuring devices having no self-contained alarm setpoint (fixed threshold). The alarm decision for each detector shall be determined by the FACP. The control panel shall determine the condition of each detector by comparing the detector's value to the stored values.
4. The FACP shall maintain a moving average of the detectors' smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain a constant smoke obscuration sensitivity for each detector (via the floating threshold) by compensating for environmental factors. Photoelectric detector's smoke obscuration sensitivity shall be adjustable to within 0.3% of either limit of the UL window (0.5% to 4.0%) to compensate for any environment.
5. The system shall automatically indicate when an individual detector needs cleaning. When a detector's average value reaches a predetermined level, a trouble MESSAGE shall be audibly and visibly indicated at the FACP for the individual detector. Additionally, the LED on the detector base shall glow steady giving a visible indication at the detector's location. If the trouble condition is left unattended, and the detector's average value increases to a second predetermined value, another trouble MESSAGE shall be indicated at the FACP for the individual detector. To prevent false alarms, these TROUBLE conditions shall in no way decrease the amount of smoke obscuration necessary for system activation. For scheduling of maintenance, the control panel shall be able to generate a MESSAGE indication for any detector approaching a trouble condition because of dirt or contamination.

### 3.02 ALARM SEQUENCE

- A. The system alarm operation subsequent to the alarm activation of any manual station or automatic detection device shall be as follows:
1. All audible alarm notification appliances shall sound with the following characteristics: Temporal code pattern until silenced by the alarm silence switch at the FACP.
  2. All visible alarm notification appliances: Xenon Strobes shall display a continuous (synchronized where indicated on the drawings) pattern until system is reset. Strobe intensities are indicated on the plans for adherence with ADA.
  3. Alarm horns and strobes shall be wired and operate independently.
  4. All doors normally held open by door control devices shall release.

5. A supervised signal to notify the central station is to be activated.
- B. The FACP shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.
- C. Activation of an auxiliary bypass means shall override the automatic functions either selectively or throughout the system.
- D. The system shall have an alarm list means that shall allow the operator to display all alarms, troubles, and supervisory service conditions with the time of occurrence. This shall allow for the determination of the most recent alarm and may also indicate the path that the fire is taking.
- E. All doors normally held open by door control devices shall release upon AC power failure.

### 3.03 POWER REQUIREMENTS

- A. The FACP shall receive 120 VAC (as noted on the drawings) from a dedicated circuit. This branch circuit shall have a "breaker lock" to prevent accidentally deenergizing of the power to the fire alarm panel. Circuit breakers shall be painted red and labeled "FIRE ALARM."
- B. The FACP shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC mains' power in a normal supervisory mode for a period of twenty-four hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
- C. The FACP shall include a disconnect switch for the AC power inside an enclosure near the panel or within the panel itself. This switch shall be labeled "Fire Alarm Power Disconnect."
- D. Isolated Loop Circuit Protectors (ILCP):
  1. The FACP shall include Isolated Loop Circuit Protector (ILCP) on all circuit which extends beyond the building. These circuits include, but are not limited to, the initiating device circuits, alarm notification appliance circuits, and signaling line circuits. ILCP shall be located as close as practical to the point where the circuits leave or enter a building.
  2. The ILCP grounding conductor shall be a No. 12 AWG wire having a maximum length of 25 feet. It shall be run in a straight line and connected to the building grounding electrode system.
  3. The ILCP shall have a line-to-line response time of less than one nanosecond. Spark gap devices or devices incorporated in or installed within the control panel in lieu of the ILCP are not acceptable.

### 3.04 SUPERVISION

- A. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.
- B. There shall be supervisory service initiation device circuits for connection of all sprinkler flow and tamper switches. Device activation shall be appropriately annunciated at the FACP.

- C. Auxiliary manual controls shall be supervised so that an “off normal” position of any switch shall cause an “off normal” system trouble.
- D. Auxiliary circuits for addressable relays shall be supervised so that a blown fuse or an open in the circuit shall be visibly and audibly annunciated.
- E. Each independently supervised circuit shall include a discrete visible amber “Trouble” LED to indicate disarrangement conditions per circuit.
- F. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green “power on” LED shall be displayed continuously while incoming power is present.
- G. The system’s batteries shall be supervised so that a low battery condition or disconnection of any battery shall be audibly and visually indicated at the control panel and the remote annunciator.
- H. The System Modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- I. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

### 3.05 INSTALLATION

- A. The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable requirements of NFPA 70–Article 760 and the manufacturer’s recommendations.
- B. If field conditions require, cover all smoke detection devices with plastic bags immediately after installation to maintain cleanliness.
- C. Class B circuiting shall be used.

### 3.06 RACEWAYS

- A. All wiring shall be in a conduit system separate from all other building wiring. See Section 16110–Conduit for specifications.
- B. All wiring shall be installed in minimum 3/4-inch conduit.
- C. Surface access to existing alarm initiating circuits in public areas shall be via UL listed surface metal raceways (minimum equivalent to 3/4-inch conduit) and box extensions.
- D. There shall be no sharp edges with installed materials.

### 3.07 CONDUCTORS

- A. All cable shall be installed according to NEC Article 760.

- B. All cables and wires shall be No. 14 AWG and larger and shall be stranded.
- C. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in the system, an audible and visual trouble signal shall be activated until the system is restored to normal.
- D. All conductors shall be color-coded. Coding shall be consistent throughout the facility. Green wire shall be used only for equipment ground.
- E. FACP shall be connected to separate dedicated branch circuit from the building emergency panel, maximum 20 amperes. Circuit shall be labeled as "FIRE ALARM."
- F. Power wiring for FACP shall be No. 12 AWG.
- G. FACP shall have No. 12 AWG green equipment ground wire. Where fire alarm circuits enter or leave a building, additional transient 75 to 90 volt gas tube protection shall be provided for each conductor.
- H. Leave 8-inch wire tails at each device box and 36-inch wire tails at the FACP and Remote Annunciator Panel(s).
- I. Cable for Intelligent Detector Loops shall be 18 to 12 AWG twisted pair with a shield jacket installed in 3/4-inch conduit. Shield continuity must be maintained and connected to earth ground only at the control panel. Intelligent detector wiring must not be in the same conduit with 120/240 VAC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B intelligent loop circuits.
- J. Wiring of alarm horn circuits and alarm strobe circuits shall be No. 14 AWG minimum.
- K. Fire alarm cables shall be held in place at the device box by means of a two-screw connector (do not use squeeze- or crimp-type connectors).
- L. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and/or labeled "FIRE ALARM SYSTEM" by decal or other approved markings.
- M. Speaker and strobe circuits shall have separate conductors and shall operate independently of each other.
- N. Speaker wiring shall be 18 AWG twisted shielded cable or as recommend by manufacturer.
- O. Strobe wiring shall be 14 AWG minimum or as recommend by manufacturer.
- P. Tray cable is not acceptable for use as fire alarm systems wiring.

### 3.08 DEVICE MOUNTING

- A. Unless otherwise noted on the drawings, the recommended mounting heights and requirements are as follows:

1. FACP: Mount control panels so all visual indicators and controls are at 60 inches above floor level. Cabinet shall be grounded to either a cold water pipe or grounding rod.
2. Audio-Visual Devices:
  - a. Install flush, semiflush, or surface mount at 6 inches below finished ceiling or at 80 inches from the bottom of the device to the highest level of the finished floor. No devices protruding 4 inches or more shall be installed lower than 80 inches.
  - b. All audio/visual devices shall be installed at the same height throughout the facility.
  - c. For surface mounting, use manufacturer-supplied backboxes and trim plates. Mark each device with its circuit number.
3. Manual Stations:
  - a. The operable part of the manual stations shall be installed not less than 3 1/2 feet (42 inches) and not more than 4 1/2 feet (54 inches) above finished floor. All Manual Stations shall be in unobstructed locations. Mark the unit's address on the inside and outside of housing. For surface mounting, use manufacturer-supplied backboxes and trim plates
  - b. All pull stations shall be installed at the same height throughout the facility.
4. Smoke Detectors:
  - a. The location of detectors shown on the plans is schematic only. The detectors must be located according to code requirements.
  - b. Surface mounted detectors shall be installed using backboxes equal to the base's size. Standard octagon and square boxes are not acceptable.
  - c. Detectors should be located on the highest part of a smooth ceiling so that the edge of the detector is no closer than 4 inches from a sidewall. Ceilings with beams, joists, or soffits that exceed 8 inches in depth require special planning and closer spacing. Verify with manufacturer.
  - d. If it is necessary to mount a detector upon a sidewall, the top of the detector shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.
  - e. Smoke detectors should be installed to favor the air flow towards return openings and not located closer than 3 feet from air supply diffusers which could dilute smoke before it reaches the detector. No detectors shall be installed in direct airflow.
  - f. Ideally, heat and smoke detectors should be located near the center of the open area which they are protecting, thus providing coverage generally for 15-foot radius for smoke detectors and a 25-foot radius for heat detectors. Verify location with ENGINEER.
  - g. Mark the address and loop number on each detector's base.
5. Identification: All junction boxes shall be painted red and labeled "Fire Alarm."

### 3.09 FIELD START-UP AND COMMISSIONING

- A. Provide the services of a manufacturer's qualified, NICET certified technician 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 checkout of the equipment. Upon completion of the manufacturer's start-up and checkout, the manufacturer shall generate a site start-up and functional checkout report, documenting all

systems checked as well as any incomplete work remaining and operational deficiencies. CONTRACTOR shall provide three copies of the manufacturer's site start-up and functional checkout report to ENGINEER for review.

- C. CONTRACTOR shall be responsible for all costs required to check operation of the system.
- D. The completed fire alarm system shall be fully tested by the manufacturer in accordance with the Wisconsin Building Code, and all applicable local building codes in the presence of OWNER's representative and the Local Fire Marshal. Upon completion of a successful test, a certification will be issued, in writing, to OWNER and CONTRACTOR.

### 3.10 TRAINING

- A. Upon successful completion of checkout by ENGINEER, a manufacturer's representative shall provide a demonstration of the automated sequences of operation. After this demonstration and acceptance by OWNER, the manufacturer shall provide 4 hours of "hands-on" training for OWNER's operating personnel which shall cover the following topics:
  - 1. Overall System Description and Theory of Operation.
  - 2. Automatic Operation.
  - 3. Manual Operation and Testing of System Devices.
  - 4. Recommended System Check Lists and Log Sheets.
  - 5. Recommended Preventative Maintenance.
- B. One 2-hour training session for two operators shall be provided. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, controls, protective devices, and other major components. Travel time and expenses to the jobsite shall be over and above the time required to perform the training and shall be included in the Bid.

### 3.11 WARRANTY

- A. The manufacturer shall warrant that all equipment shall be free from defects in material and workmanship under normal and proper use and service for a period of one year after substantial completion.

### 3.12 FIRE ALARM WIRE AND CABLE COLOR CODE

- A. Provide fire alarm circuit conductors with color-coded insulation or other permanent identification at each conductor termination and in each junction box. All fire alarm wiring must be in conduit.

END OF SECTION

## SECTION 16930

### 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 1 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this Section as listed in Division 1.
- B. Qualifications of Installers: Use 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 01300–Submittals.

#### PART 2–PRODUCTS

##### 2.01 GENERAL

- A. All materials of construction for cable and wire shall be compatible and noncontaminating.
- B. Unless otherwise noted in these specifications, the requirements herein listed shall be strictly adhered to.

##### 2.02 SHIELDED PAIR CABLING FOR ELECTRONIC INSTRUMENTS

- A. Shielded pair cabling shall have stranded, tinned copper conductors, No. 16 AWG, twisted with 2-inch lay.
- B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.

- C. Color coding shall be manufacturer's standard or as stated.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils-thick, and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power limited circuit cable.
- E. If the cabling is not installed in steel conduits, a 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A No. 18 AWG, 7 strand, tinned copper drain wire shall be furnished in continuous electrical contact with the shield.
- F. Single pair, shielded cables shall be Belden 9316, or equal.

#### 2.03 SHIELDED MULTICONDUCTOR CABLING FOR ELECTRONIC INSTRUMENTS

- A. All multiconductor cables for instruments shall be in accordance with this section unless there are unusual requirements by the instrument vendor.
- B. Multiconductor cables shall have No. 20 AWG, stranded tinned copper conductors, arranged in pairs or triples, twisted with 1 1/2 inches to 2 1/2 inches staggered lay.
- C. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties. Pairs or triples shall be numbered consecutively.
- D. Color coding shall be manufacturer's standard or as stated.
- E. An overall 100% coverage shield consisting of 2.35 mil aluminum mylar tape shall cover the conductors with a No. 20 AWG, 7 strand, tinned copper drain wire in continuous electrical contact with the shield.
- F. The outer jacket shall be flame-retardant and ultraviolet-resistant PVC, 50 mils minimum thickness and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited cable.
- G. For flow meters or other signals requiring low cross-talk characteristics, each pair or triple shall have a separate, insulated, 100% coverage shield consisting of an 0.85 mil minimum thickness aluminum mylar tape with No. 22 AWG, 7 strand, tinned copper drain wire in continuous electrical contact with the shield.

#### 2.04 INDUSTRIAL ETHERNET CABLE

- A. For communication with plant SCADA systems and equipment in supervisory control centers, motor control centers, control panels, etc., and areas with 480-volt power, provide 600V rated, 4-pair **shielded** twisted-pair cabling meeting EIA/TIA Category 5e requirements. Transmission characteristics of the cables shall meet full Category 5e performance criteria as defined by the referenced TIA/EIA documents and this specification. Jacket color shall be teal.

- B. Industrial Ethernet cable shall be minimum 24 AWG with PVC jacket and foil and braided shield. The cable outer jacket shall be industrial grade PVC with a nominal overall cable diameter of 0.32 inches. Cable shall be non-plenum rated, UL listed, 600V UL AWM rated, and be as manufactured by Rockwell Automation Bulletin 1585-C8HB, Belden 7958A, or equal.
- C. Patch cables shall be provided pre-manufactured by the cable manufacturer or connector manufacturer in sufficient length to connect associated equipment to any port on the patch panel or switch. Field attached plugs shall be insulation displacement type and be by the same manufacturer as the cable or connector.
- D. Faceplates shall be Leviton 42080 series Ivory, or equal in “finished areas.” Stainless steel shall be used in all other areas and be Leviton 43080 series, or equal.
- E. Cat 5e shielded connectors shall be Leviton 5S180-SH5, or equal.
- F. Patch panels shall be shielded and include star washers and grounding lug, with stainless steel plate to provide grounding continuity between connectors and panel. Shielded patch panels shall be Leviton 4S255 series, or equal.

## 2.05 CATEGORY 5E CABLING

- A. Commercial Data and Voice Cabling: Provide 4-pair Unshielded twisted-pair cabling meeting EIA/TIA Category 5e requirements for HORIZONTAL VOICE AND DATA CABLING (STATION CABLING). Cable shall be rated for spaces as indicated on the drawings. Provide Systimax Solutions 1061 Low Smoke PVC or equal for non-plenum environments.
  - 1. Data and Voice Station Cables: Transmission characteristics of the Data Station Cables shall meet full Category 5e performance criteria as defined by the referenced TIA/EIA documents and this specification. Refer to the Execution Section which details the required performance criteria of the Permanent Link of which the Cable is a part. The jacket color for Data cables shall be BLUE. The jacket color for “Voice” cables shall be WHITE.
  - 2. Cabling shall be used for video cameras.
- B. Faceplates: Systimax Solutions: “L” Type Flush Mounted, Ivory, or equal, in “finished areas.” Stainless steel “SP-L” type plates shall be used in all other areas.
- C. Jacks: Systimax Solutions: MGS100E-246 (Ivory) for voice, MGS100E-112 (orange) for data, or equal.

## PART 3–EXECUTION

### 3.01 FIBER OPTIC CABLE INSTALLATION

- A. Provide minimum 30 feet of slack in all cables within all electrical handholes.
- B. Use cable tie tool to install cable ties to manage cable slack. Cable tie tool shall apply appropriate pressure to the cable bundles so not to damage cable and provide a smooth cut of excess cable tie. Cable ties MUST be able to be turned freely around the bundle of cable. Cable bundles shall be limited to 3-inch diameter.

- C. Use Velcro bands to secure cable bundles within interior pull boxes and fiber patch panels.
- D. Avoid excessive and sharp bends. Ensure manufacturer's recommended bend radius and pulling tensions are not exceeded.
- E. Fittings or connections are allowed only at the input and output of devices. Splicing shall not be accepted in any cable run. The entire cable run shall be replaced in all such instances.
- F. All cable shall be installed in conduit.
- G. Conduit, raceways, and outlet boxes shall be provided as required.
- H. Cable slack shall be provided at end of the fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designated for this purpose. Multiple cables may share a common enclosure. A minimum of 15 feet of slack cable shall be coiled and secured at each end of the fiber optic cable. Exact cable termination locations shall be field verified with OWNER and ENGINEER.

### 3.02 INSTALLATION REQUIREMENTS AND SPECIAL CONSIDERATIONS

- A. Shielded pair fiber optic and industrial ethernet, specified in this section shall be installed in conduit and may not be run free-air or in non-metallic tubing such as innerduct.
- B. Although twisted conductors effectively reduce magnetic noise, where additional magnetic shield is necessary to minimize interference from stray magnetic fields, armored cable and thermocouple lead extension wire shall be provided.
- C. Since magnetic interference is produced by currents flowing through conductors and electrical equipment, any instrument wire run near electric motors, transformers, circuit breakers, motor starters, power lines, or AC power and control cables may need additional magnetic shielding.
- D. Armor may be necessary on instrument cables installed in ladder-type trays or in nonmagnetic electrical ducts.
  - 1. Electronic instrument wiring, pairs. There shall be a steel wire armor of 24 gauge AISI 1006 soft annealed steel wire covering the inner jacket.
  - 2. Electronic instrument wiring. There shall be a flexible interlocked galvanized steel armor covering the inner jacket.
  - 3. The armor shall be covered by a flame-retardant and weather- and ultraviolet-resistant PVC, outer jacket 35 mil minimum thickness and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited cables.
- E. Cable slack shall be provided at end of the fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designated for this purpose. Multiple cables may share a common enclosure. A minimum of 15 feet of slack cable shall be coiled and secured at each end of

the fiber optic cable. Exact cable termination locations shall be field verified with OWNER and ENGINEER.

### 3.03 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 water-tight 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. The single-pair electronic instrument cable shields shall be connected to the multipair electronic instrument cable overall shield in the field junction box. The multipair electronic cable overall shield shall be grounded to the control room instrument ground.
- E. Cable shield grounds shall be isolated from control system signal grounds, except at instrument system grounding electrodes.
- F. The control room instrument ground shall be separate and isolated from the electrical power grounding system.

### 3.04 STATION CABLE AND TERMINATION COMPONENTS

- A. Individual labels shall be placed on all Telecommunications Outlets, Data Patch, Voice Termination Blocks, and cables. This is inclusive of each voice, data, outlet, or any configuration thereof, as identified on the drawings.
- B. Each component shall be clearly labeled using a code identifying each information outlet location throughout the facility. The project documents identify the numbering at each outlet location. Each media type shall be numbered separately. The format of the identifier shall be as follows:
  - 1. Cable-type (D=data, V=voice), jack number.
  - 2. For example: "D-001" represents the first data jack served from the Server Room. A voice outlet at the same location would be labeled as V-001.
- C. Labeling:
  - 1. Pan Net machine fed labels, or equal, self-adhesive typed labels shall be utilized as follows:
    - a. Place labels on faceplates adjacent to each jack.
    - b. Label all patch panel terminations at each jack location.
    - c. Label each end of all cabling runs with a label at 3 inches to 5 inches from the termination.
  - 2. ALL labels MUST be by the same manufacturer, same size and same font, and comply with ANSI/TIA/EIA-606-A-1.

- D. Labels shall be White background with Black lettering. Lettering size shall be as large as practicable (up to 16-point) to fit properly on the outlet label. No lettering shall be smaller than 12-point.

### 3.05 TESTING AND ACCEPTANCE

#### A. General:

1. CONTRACTOR is responsible to perform certification tests as indicated below for each sub-system (e.g. backbone, station, etc. ) as it is completed.
2. CONTRACTOR is responsible for supplying all equipment and personnel necessary to conduct the certification tests. Prior to testing, CONTRACTOR shall provide a summary of the proposed test plan for each cable type including equipment to be used, set-up, test frequencies or wavelengths, results format, etc. The method of testing shall be approved by ENGINEER.
3. CONTRACTOR shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. CONTRACTOR shall provide ENGINEER with a written certification that this inspection has been made.
4. CONTRACTOR shall conduct certification testing according to a schedule coordinated with OWNER. Representatives of OWNER may be in attendance to witness the test procedures. CONTRACTOR shall provide a minimum of one (1) week advance notice to ENGINEER as to allow for such participation. The notification shall include a written description of the proposed tests including copies of blank test result sheets to be used.
5. IMPORTANT: Failure to provide the above information shall be grounds for OWNER/ENGINEER to reject any and all Documentation of Results on related testing and to require a repeat of the affected test.
6. Tests related to connected equipment of others shall only be done with the permission and presence of CONTRACTOR involved. CONTRACTOR shall ascertain that testing only as required to prove the wiring connections are correct.
7. CONTRACTOR shall provide test results and describe the method of the tests including the date of the tests, the equipment used and the procedures followed. At the request of ENGINEER, CONTRACTOR shall provide copies of the original test results.
8. All cabling shall be 100% fault free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of CONTRACTOR. The applicable tests shall then be repeated.
9. Should it be found by ENGINEER that the materials or any portion thereof furnished and installed under this contract fail to comply with the specifications and drawings, with the respect or regard to the quality, amount of value of materials, appliances or labor used in the work, it shall be rejected and replaced by CONTRACTOR and all work distributed by changes necessitated in consequence of said defects or imperfections shall be made good at CONTRACTOR's expense.

- B. Warranty: CONTRACTOR shall guarantee all materials, equipment, etc., two years from date of substantial completion of this work. In the case of data cabling contractor shall furnish complete Category 5e system warranty consisting of no less than two years. This guarantee shall include all labor, material and travel time. See Division 1-General Conditions for further requirements.

END OF SECTION

SECTION 16940

CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

- A. Allowances: SYSTEM SUPPLIER 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.
  - 1. Card Reader Access System Allowance–Section 2.12–Card Access System.
  - 2. Video Surveillance System Allowance–Section 2.13–Video Surveillance System.
  - 3. SCADA Software Implements at Master Station–Section 3.02–Supervisory Control Center (SCC-15).
  
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 1 shall govern work in this section.
  - 2. Section 16941-Controls and Instrumentation Drawings.

PART 1–GENERAL .....	1
1.01 SUMMARY.....	1
1.02 SYSTEM DESCRIPTION .....	2
1.03 QUALITY ASSURANCE.....	2
1.04 SUBMITTALS.....	3
1.05 OPERATION AND MAINTENANCE DATA .....	3
1.06 DELIVERY, STORAGE, AND HOLDING .....	4
1.07 DESCRIPTION OF THE MADISON WELL NO. 15 CONTROL SYSTEM.....	4
1.08 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS .....	4
1.09 SYSTEM START-UP, AND SUPPORT SERVICES .....	6
1.10 EQUIPMENT ENCLOSURES .....	7
1.11 COMMON REQUIREMENTS ALL EQUIPMENT.....	8
1.12 GENERAL CONTROL ALGORITHMS.....	9
1.13 SPARE PARTS .....	11
PART 2–PRODUCTS.....	12
2.01 INDUSTRIAL CONTROL AND POWER RELAYS.....	12
2.02 PLC TELEMETRY SYSTEMS AND PLC SOFTWARE .....	12
2.03 FLOAT SWITCHES.....	16
2.04 LIMIT SWITCHES.....	17
2.05 SUBMERSIBLE LEVEL TRANSMITTERS .....	17
2.06 THERMOSTATS.....	18
2.07 TVSS DEVICES FOR CONTROL PANELS AND INSTRUMENTATION EQUIPMENT .....	18
2.08 PRE-LUBE FLOW SWITCHES .....	18
2.09 INDUSTRIAL ETHERNET SWITCHES.....	18
2.10 MAGNETIC FLOW METERS .....	18
2.11 MOTION DETECTORS.....	19
2.12 CARD ACCESS SYSTEM.....	19
2.13 VIDEO SURVEILLANCE SYSTEM.....	20
2.14 THERMAL MASS AIR FLOW METERS.....	20
2.15 SUBMERSIBLE DRAWDOWN TRANSDUCERS.....	20

2.16	PRESSURE TRANSDUCERS .....	21
3.01	MADISON WELL NO. 15 MOTOR CONTROL CENTER (MCC-15 NOTES).....	22
3.02	SUPERVISORY CONTROL CENTER (SCC-15) .....	25

1.02 SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation the Control System for the City of Madison Well No. 15.
- 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, the SCADA System computers, hardware, system drawings, system software, new MCC at the wellhouse, and MCC modification drawings as necessary. See paragraph 1.08 for other System Supplier requirements.
- 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 and 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 ensure 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 a manner fully satisfactory to ENGINEER. This will 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 telemetry equipment and controls shall be installed in new or existing, as necessary by System Supplier, supervisory control panels at locations where space allows.

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 01300-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, start-up, 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 SCCs and MCCs, including modification drawings for existing equipment.
  - 6. PLC I/O listing.
  - 7. Database with PLC addresses.
  - 8. Software.
  - 9. PLC programs and software.
  - 10. Control narratives.

#### 1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01300-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 1. The following additional information shall apply:
  - 1. Manuals shall contain, but not be limited to, the following:
    - a. System Hardware.
    - b. System Software.
  - 2. Hardware section shall include:
    - a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.

- b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.
  - c. Listing of all hardware timers installed in MCC and SCC, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of start-up.
3. Software section shall include:
- a. Software manual shall describe system techniques, general philosophies, list, and description of all standard software. System techniques description shall include a detailed screen-by-screen description explaining where the various signals originate, how to change equipment setpoints and control modes, how alarms are acknowledged, and how to go from screen to screen. All menu selections and their functions shall also be described in detail.
  - b. Program documentation (i.e., PLCs, radios, computer) shall include programs, documentation files, database, and configuration as installed in both hard copy as well as two copies of backup disks of this information. Passwords for all programmable devices (i.e., PLCs, radios, computer) shall be turned over to OWNER at the time of final completion.

#### 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 SCC components, enclosure, and finish.

#### 1.07 DESCRIPTION OF THE MADISON WELL NO. 15 CONTROL SYSTEM

- A. The Madison Water Utility consists of 26 active wells and 30 booster pumping facilities. As an addition to the current system, modifications to Well No. 15 shall be provided as specified in this Contract. New information shall be sent via radio telemetry to the existing City of Madison master site (Master Station).
- B. System Supplier shall be responsible for the development of all process control functions based on the algorithms described in this specification. Many systems encompass several algorithms for system components.

#### 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.
- 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, software, 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 ensure 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 water distribution 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 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.
  - 2. Provide materials, instructors, and workbooks to complete the training.
  - 3. Training courses shall include:
    - a. Operator training. Course length minimum eight hours. Training shall utilize equipment specified herein following installation and field testing.
    - b. Maintenance training for four operators. Course length minimum four hours.
  - 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.
- I. All components are to be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid supervisory system System Supplier shall be L.W. Allen-Altronex, (608) 222-8622. See General Conditions and Supplementary Conditions regarding substitutions to the Base Bid System Suppliers.

#### 1.09 SYSTEM START-UP, AND SUPPORT SERVICES

- A. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for test, ENGINEER will make one one-day trip to check operation. If the equipment does not operate according to the specifications, there will be deducted from payments due CONTRACTOR the amount of \$1,500 a day for ENGINEER's time plus travel and expenses 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 and will make payment to ENGINEER.
- B. 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 ensure 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 I/O control loops.
  2. Satisfactory operation of software.
  3. Satisfactory operation of control program.
  4. Satisfactory operation of peripheral equipment.
  5. The necessary debugging programs have been performed.
  6. Data output is reliable.
  7. Control loops are operational.
  8. Checking and calibrating of systems have been completed.
  9. Reports are operational and give correct data.
- C. CONTRACTOR, through System Supplier, shall provide the following support services:
1. Field Service Engineer. Field Service Engineer shall be responsible for programming of system PLCs in the factory and at the site. Field Service Engineer shall be present at the factory acceptance test and be present for start-up of all systems and available throughout the entire construction process until final completion. Service technicians sent for system start-up will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
    - a. Commissioning, installation, start-up, and testing of equipment.
    - b. Revising or rewriting manuals to incorporate an installed and accepted system.
    - c. On-site training.
    - d. Software modifications.
  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. Program modifications.

- c. Revising or rewriting manuals.
3. Post start-up support shall include follow-up services during the one-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 16 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 this 16 hours includes two trips to the site.

#### 1.10 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 12 gauge steel, and continuous 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 18-inch fluorescent light and switch. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust inhibiting enamel, white 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 a minimum of 30 inches wide, 20 inches deep, and 90 inches high and shall be as manufactured by Hoffman, Lehman, or Saginaw. MCC structures are not acceptable. Where installed next to Motor Control Centers, enclosure painting shall match that of the MCC.
- B. Indication gauges shall be at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of gauge.
- C. 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.
- 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. 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. 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.
- F. 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.

- G. All panels with DIN rail mounted equipment shall include a minimum of 25% spare DIN rail space.
- H. 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).
- I. 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 motor control power shall be 120 volt with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- C. Devices powered at 120 volts from supervisory control panels shall be fused. This shall include, but not be limited to, solenoid valves, flowmeters, scales, and transducers.
- D. 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.
- E. 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.
- F. 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.
- G. Where a certain accuracy of sensing and transmitting levels or flows and controlling operations are called for, means must be provided to read or determine that the levels or flows 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.
- H. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.

## 1.12 GENERAL CONTROL ALGORITHMS

- A. In general, the following is a definition of I/O at each MCC:
  - 1. Run from MCC or auxiliary starter contact (dry contact).
  - 2. Fail from MCC or starter auxiliary O.L. contact (dry contact).
  - 3. Command Run Maintained start or as required (dry contact).
  - 4. Hand-Auto from MCC or Controller Selector Switch (dry contact), feedback to SCADA.
  - 5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.
- B. Programming algorithms described herein and in Part 3—Execution shall reside within the PLC associated with that equipment and not in the master PLC. Polling sequences shall be setup to poll remote data based on the data type (e.g. alarms, historical) such that data transmission rates are not adversely affected.
- C. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate the SCADA to the alarm state.
- D. All analog and digital inputs shall be monitored and totalized in the PLC. This shall include, but not be limited to, flows (air, water, etc.), weights, pressures, and levels. The PLC shall calculate maximum, minimum, and running average for all analog inputs. Instantaneous values, totals, maximum, minimum, and average values shall be read by the HMI software and be reset on a daily basis as described below. Minimum, maximum, and average values shall be stored in the PLC for the current day and previous day.
- E. PLCs shall calculate equipment runtimes and number of starts for all equipment where run signals are monitored. Runtimes and number of starts shall be read by the HMI software and be reset on a daily basis as described below.
- F. Totalized flow values, chemical usage, and equipment runtimes as described above shall be stored in the PLC for a period of five days. This data shall be available for use by the HMI software for importing into a reporting software package for purposes of daily, weekly, and monthly reporting. The PLC shall indicate the specific date for each of the five previous days.
- G. Daily flow totals, chemical usage, runtimes, number of starts, and number of cycles as described above shall be reset on a daily basis. This reset shall occur based on a time (hour and minute) setpoint stored in the PLC through the HMI software. The operator shall set the time when the daily reset will occur. Once this time setpoint matches the current time of the processor clock, the Master PLC shall send a reset signal to PLC to clear any totals that have accumulated locally.
- H. In addition to the totalizers described above, the PLC shall also calculate cumulative totals for all runtimes, number of starts, flows, and chemical (weight) usage. Maximum, minimum, and running average for all analog inputs shall also be included as part of the cumulative total algorithm. Cumulative totals shall totalize until manually reset by the operator. There shall be a manual reset for each signal. The PLC shall display the date of the last cumulative totalizer reset for each signal.
- I. System Supplier shall provide addressing for all hard-coded time delays and PLC settings that are not operator-adjustable. This shall include, but not be limited to, time delays for float switches, call-to-run fails, level alarms, pressure alarms, flow alarms, weight alarms,

temperature alarms, and data fail alarms. Indication of time remaining for all timers within PLCs shall be made available for indication at the SCADA System.

- J. Float switches shall include time delays to prevent intermittent starting and stopping and/or alarming because of bouncing floats.
- K. Solenoid valves that are not provided with position indication (e.g., opened, closed) shall include hard-coded time delays on the open and close signals to allow operation of the solenoid or valve.
- L. System Supplier shall provide addressing for all PLC fault codes so that the error number and associated description can be displayed at the SCADA System.
- M. All analog signals shall be scaled to engineering units in the PLC with implied decimal to allow storage in integer registers. System Supplier shall provide all analog ranges, PLC register values, and associated scaling factors to ENGINEER for use with the HMI software. This shall include upper and lower limits of PLC registers (i.e., -32768 to 32767 or 0 to 65535) as well as upper and lower limits for the associated device (i.e., 0 to 150 psi). Analog values specified to be displayed with decimal points shall be scaled by the HMI software.
- N. For all weight, pressure or level sensing devices, provide a Transducer Fail alarm at the SCADA System for each transducer. Transducer fail shall be defined as the signal from the transducer being out of range or not changing for an operator-adjustable time period (0 to 120 minutes).
- O. Provide "Out of Service" indication for each piece of equipment when that equipment's MCC or SCADA H-O-A is not in the Auto position.
- P. All analog signals shall have associated high and low setpoints and alarms. Alarms shall be tied into the dialer and paging system specified herein.
- Q. PLCs shall be set up so that the ranges of all analog input signals to the PLC I/O cards can be configured from the HMI software. Provide two operator-adjustable setpoints for each analog input, one corresponding to 4 mA and the other corresponding to 20 mA. These setpoints are applicable to devices attached to the PLC. This feature is intended to be used for start-up and calibration purposes.
- R. All equipment controlled automatically from the SCADA System shall have "Call-to-Run" signals generated from their associated PLCs. These signals shall be displayed at the SCADA System through the HMI software. Each associated PLC shall also generate a "Call-to-Run Fail" if the equipment is called-to-run but does not start within a specific time period. Call-to-run signals may be generated by the master or remote PLC as determined by System Supplier. The "Call-to-Run" signal shall be generated within the PLC software and may not be combined with other fail signals such as hard-wired motor fails, and overtemperature.
- S. All valves controlled automatically from the SCADA System shall have "Call-to-Open/Close" signals (as applicable) generated from their associated PLCs. These signals shall be displayed at the SCADA System through the HMI software. Each associated PLC shall also generate a "Call-to-Open/Close Fail" if the valve/gate is called-to-open/close but does not open/close within a specific time period.

Call-to-open/close signals may be generated by the master or remote PLC as determined by System Supplier. The “Call-to-Open/Close Fail” signal shall be generated within the PLC software and may not be combined with other fail signals such as hard-wired motor fails, and overtemperature.

- T. All controlled equipment as described herein shall have the capability of manual control from the HMI software through the manipulation of analog or digital variables. This shall be through the use of a “SCADA H-O-A” switch or by forcing a single I/O point as a manual start command. All analog and digital outputs shall be capable of being manually set from the HMI software.
- U. Where a manual reset is required at the SCADA system (i.e., level lockout, pressure lockout), the HMI software shall be configured to set a discrete reset bit. Once the PLC receives the bit and the alarm condition has cleared, the PLC shall clear the alarm and place the associated equipment back in service.
- V. Provide an analog PLC register for each piece of equipment with a SCADA H-O-A switch. Register shall be used for color animation associated with that equipment’s HMI graphic object. Analog register value shall be as follows: 0 = Off/Out of Service, 1 = In Auto at MCC, 2 = PLC Call-to-Run, 3 = Running, 4 = Failed (Call-to-Run, Starter Overload, etc.). Precedence shall be given to the higher number conditions; for example, if a pump is In Auto but has failed, the register value shall be 4.
- W. The SCADA System shall allow the operator to change all setpoints and operating parameters within the PLCs as described herein. All control algorithms and alarms for equipment shall be programmed in the associated PLC and not in the master. There shall be no control algorithms or alarms in the computers. Control of each piece of equipment shall be accomplished as described herein and in Part 3–Execution of this section.
- X. Battery status of PLC shall be monitored by the SCADA System. In the event of a low battery condition, an alarm shall be generated at the SCADA System.
- Y. Wiring diagrams for all panels shall be included as part of the SCADA HMI. All wiring diagrams shall be provided to ENGINEER in a read-only format so that through the HMI, the operator will have the ability to view panel wiring diagrams from the SCADA computer. Acceptable electronic formats include .pdf, .jpg, .gif.
- Z. Radios installed in telemetry panels (master and remote) shall be powered through a normally closed control power relay contact. If the PLC detects a communication fail, the PLC shall energize the control power relay that will deenergize power to the radio. The relay shall be energized for five seconds and then deenergized. Communication fail time delays shall be adjusted during start-up based on the quantity of telemetry panels.

### 1.13 SPARE PARTS

- A. System Supplier shall furnish spare parts for equipment specified herein as listed in Section 16951–Spare Parts.

## 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, 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.
- 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: 8A (DPDT), 16A (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: 15A, 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: 20A continuous; 1 hp.
    - e. Operating life: 10 million cycles.
    - f. UL listed.
    - g. NEMA rated.
    - h. Manufacturer: Allen Bradley, 700-PK, or equal.

### 2.02 PLC TELEMETRY SYSTEMS AND PLC SOFTWARE

- A. All control signals, status signals, alarm, and variable analog data shall be transmitted and received between the existing master data gathering site and Well No. 15 (SCC-15) using digital telemetry. The mode of communication for the PLCs shall be via radios as specified herein. The SCADA System shall convert commands, alarms, and variable analog data to digital data blocks and transmit this information between the existing master and Well No. 15.
- B. The digital blocks of data shall be sent/received in half-duplex mode from the Telemetry system to the PLCs via Ethernet. The digital data shall be converted for radio transmission by internally mounted modems supplied by the Radio Telemetry System manufacturer (see

Radio Telemetry System). The PLC System and Radio Telemetry System shall be fully data compatible.

- C. Data security shall be provided by a complimentary double scan and a cycle redundancy check (CRC) code.
- D. If communications cannot be verified between master and remote, the master shall try to send the data three times before a data fail output is energized.
- E. 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.
- F. 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:
    - a. Programmable Logic Controllers (PLC) consisting of CPUs with adequate memory and instructions, 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 enclosure as specified herein or as shown on the drawings; see Equipment Enclosures. The new PLC enclosure shall be completely assembled, prewired, and tested at System Supplier's factory.
    - b. Telemetry system (where required) as described elsewhere in this specification.
  - 2. PLC Programming and PLC Software: System Supplier shall provide all the PLC programming and PLC software required to meet this specification and shall be in accordance with the system configuration. The software shall include, but not necessarily be limited to, the following:
    - a. PLC logic programs to be written by System Supplier for the PLC systems to accomplish the monitoring and control functions as specified elsewhere in this specification. The supplier shall document and annotate the programs, update them as required after start-up, and then turn the programs over to OWNER in the form of compact disks; two copies are required.
  - 3. 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) PLC programming.
      - (5) Radio communication layout.

- b. Submittals: In addition to submittals previously described provide:
    - (1) Shop drawing and product data.
    - (2) PLC logic programs.
    - (3) Recommended spare parts lists.
  - c. Installation: CONTRACTOR shall install all the system equipment including PLCs and interconnecting cabling as required. This work shall include all interconnection wiring from new and existing equipment as required for the completion of the system.
4. The PLC shall be a microprocessor-based controller.
  5. The PLC processor shall meet the following minimum general specifications:
    - a. Voltage: 100 to 130 VAC.
    - 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.
  6. The PLC processor shall have the following minimum features:
    - a. 1.5 MB of battery-backed static RAM.
    - b. 64 MB nonvolatile memory (compact flash).
    - 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 30 modules.
    - i. Memory protection.
    - j. RS-232 and Ethernet communications ports for communications.
    - k. Remote I/O capability.
    - l. Status indicators.
  7. 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 or isolated 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.
  8. 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.
  9. The PLCs shall be of the modular hardware style as manufactured by Allen Bradley CompactLogix, or equal, with all accessories required to perform the operations described herein and to communicate with the fiber-optic data highway (or radio) system.
  10. 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.
  11. 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.
  12. All components comprising the PLC system shall be manufactured by a company regularly engaged in the manufacture of programmable controllers.
  13. The power supply shall be protected against short circuits.
  14. The power supply shall contain its own overcurrent and overvoltage protection.
  15. In the event of power loss, register or ladder information shall be retentive.
  16. 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.
  17. PLC shall include, but not be limited to, the following equipment:
    - a. Main PLC processor and remote I/O driver or remote I/O receiver.
    - b. Main power supply.
    - c. I/O modules and housing.
    - d. Computer-grade transient and spike suppressor.
    - e. Rail mounted terminal blocks for field wiring terminations.
    - f. Plastic wiring ducts.
    - g. General purpose duplex GFCI receptacle.
    - h. 15A, 120/240 VAC, branch circuit breakers to feed to the main PLC controller and the I/O controlled field devices.
    - i. Other accessories required to provide a complete and working PLC system.
    - j. True online UPS backup for the SCC.
    - k. Radio and antenna system.
    - l. Network switch.
    - m. Slot fillers for any unused I/O module slots.
  18. The PLC processor shall receive power from their individual power supplies, which shall be fed from dedicated 15 ampere circuit breakers through transient and spike suppressors.
- G. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for three years from start-up.
- H. 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.
- I. The color code for panel and field wiring shall be as follows:
1. Discrete 120 VAC Input:
    - a. Hot Wire: Red
    - b. Neutral Wire: White

- c. Switched Wire: Brown
  - 2. Discrete 120 VAC Output:
    - a. Hot Wire: Red
    - b. Switched Wire: Dark Blue
  - 3. 120 VAC Panel Power:
    - a. Hot Wire: Red
    - b. Neutral Wire: White
    - c. Ground Wire: Green
- J. 24 VDC power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.
- K. Current-to-current isolators shall be provided and installed in remote-mounted enclosures for isolating all existing analog input signals. NEMA rating of enclosures shall be as required for the area where installed.
- L. Manufacturer of Accessories:
  - 1. The plastic wiring duct shall be Electrovert "Electro-Duct," Panduit, or equal.
  - 2. Terminal blocks shall be Phoenix Contact UK 5 N, or equal.
  - 3. Wire markers shall meet the requirements of Section 16195-Electrical Identification.
  - 4. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be of the rail mounted-type such as Square D, Class 9080, Type GCB-150, or equal.
  - 5. Power supplies shall be Sola, rail mount, SPD or SDN Series, or equal.
  - 6. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.
- M. System Supplier shall provide the design and layout of the radio telemetry system, communication between SCC-15 and the existing SCADA system at the Master Station.
- N. System Supplier shall provide the necessary communication modules within the systems (Master and Remotes) to allow the systems to communicate with the radios.
- O. SCC shall have a true on-line UPS backup that will allow for continuous communication with the master for up to 30 minutes following a power failure. Power to SCC shall be through the UPS and shall be plug connected. UPS power shall be provided, at a minimum, to the following components: PLC and I/O racks, power supplies for PLCs, I/O, and radios, indicating lights and devices associated with power fail and communication alarms, and power supplies for loop-powered instruments. UPS shall be provided with a relay card that provides a dry contact output to the PLC in the event that the UPS batteries need replacement. UPS shall be APC with relay I/O module, Liebert GXT3 with relay card, or Powerware 9000 series. Provide a stand or shelf within SCC panel for the UPS such that the UPS does not sit on the bottom of the enclosure.

## 2.03 FLOAT SWITCHES

- A. Float switches when specified herein, shown on the drawings, or necessary to complete an operating system shall be as follows:
- 1. The float switches shall be mercury free and consist of a 316 stainless steel housing 5 1/2-inch diameter, stainless steel mounting clamp, a flexible two-conductor cable with a CPE jacket, and a potted SPST magnetic reed switch. Provide switch configuration (NO or NC) as required. The electrical load for the switch contacts shall be 100 VA at up to 250 volts. Float switches shall include a two-conductor cable

16 AWG with fine strands made for heavy flexing service and underwater use. Cable length shall be 50 feet minimum for a continuous run to the terminating control panel. A green grounding wire shall connect internally to the float housing. Floats shall be Siemens Model 9G-EF, or equal.

2. Weight and buoyancy shall be such that contaminants will not result in the float switch changing operating level more than 1 inch.
3. Operating temperature range shall be -31° to 194°F.

B. Floats shall be mounted on a stainless steel cable with PVC covered anchor per manufacturer's instructions. All mounting hardware shall be stainless steel and provided with floats.

C. Provide stainless steel kellum grips for each float cable.

#### 2.04 LIMIT SWITCHES

A. Limit switches (door switches) where called for on the drawings shall be General Electric 2500 Series, or equal.

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 application, and mounting hardware for check valve swing arm and flexible cable to junction box.

#### 2.05 SUBMERSIBLE LEVEL TRANSMITTERS

A. The liquid level of the reservoir shall be sensed by a submersible level transducer. The transducer shall be a Bulletin A1000, Model 157GSCI, condensation-protective as manufactured by Siemens/US Filter, or equal. The transducer shall be of the head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with manufacturer's instructions. The bottom diaphragm face of the sensor shall be installed 6 inches above the floor. The sensor shall be mounted using a 316 stainless steel cable and weight system; location to be determined in the field.

B. The transducer shall sense water level (pressure) variations and transform these variations directly into a standard process signal of 1 to 5 volts DC or 4-20 mA over the desired level range (span). The transducer shall be completely solid state, with no mechanical linkages or moving parts. Supply voltage shall be as required by CONTRACTOR.

C. The transducer shall incorporate a variable-capacitance transducer element to convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against a ceramic diaphragm that flexes minutely so as to vary its proximity to a ceramic substrate to vary the capacitance of an electrical field created between the two surfaces. A stable, hybrid, operational amplifier assembly shall be incorporated in the transducer to excite and demodulate the sensing mechanism. The transducer shall incorporate laser-trimmed, temperature compensation, and high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory-calibrated range.

D. The transducer shall include easily accessible offset and span adjustments. Span shall be adjustable from 100% down to 15% of the sensor range. Fine and coarse adjustments for both span and offset shall be provided using 25-turn potentiometers. Offset and span

adjustments shall be noninteractive for ease of calibration. Operating pressure range of the transducer shall be approximately 0 to 15 psig.

## 2.06 THERMOSTATS

- A. Thermostats associated with the SCADA System as specified in Section 16990-SCADA System I/O Listing shall be provided by System Supplier as specified in Section 16141-Wiring Devices. Thermostats not specified in Section 16990-SCADA System I/O Listing shall be provided as part of Section 16141-Wiring Devices.

## 2.07 TVSS DEVICES FOR CONTROL PANELS AND INSTRUMENTATION EQUIPMENT

- A. The incoming power supply of supervisory control center shall be protected with a transient voltage surge suppression (TVSS) device. TVSS unit shall be as manufactured by Citel Model M18-120, or equal.

## 2.08 PRE-LUBE FLOW SWITCHES

- A. Flow switches when specified herein, shown on the drawings, or necessary to complete an operating system shall be as follows: The flow switches shall consist of bronze housing and bonnet with 1-inch-diameter NPT ports.
- B. Flow switches shall be Gems Model FS200:
  - 1. Operating pressure range shall be 0 to 400 psi.
  - 2. Provide adjustable-type setting.
  - 3. Provide accurate flow detection with 1% repeatability.

## 2.09 INDUSTRIAL ETHERNET SWITCHES

- A. Managed Ethernet switches shall be provided for networks shown on the drawings that include any of the following: PLCs, VFDs, reduced voltage starters, operator interface panels, and any other SCADA system Ethernet-based hardware. Managed switches shall be as manufactured by Hirschmann, RS20 series, or Siemens SCALANCE X-300 series and include fiber and copper ports to accommodate wiring shown on the drawings. Each switch shall include the following.
  - 1. Selectable Ethernet star or ring topology with redundancy (ring configuration) and automatic detection of a failed fiber/ring.
  - 2. DIN rail mounting.
  - 3. Store and forward switching.
  - 4. Redundant power inputs.
  - 5. Compliance with the following IEEE standards: 802.1D, 802.1p QoS, 802.3, 802.3u, 802.3x, 802.1w RSTP, and 802.1Q VLAN.
  - 6. SNMP with Web Browsing for switch configuration and monitoring.
  - 7. Dry contact output for indication that the primary fiber loop or switch has failed.
  - 8. Copper ports as shown on drawings.
  - 9. Eight spare copper ports.

## 2.10 MAGNETIC FLOW METERS

- A. Flow meters shall be Toshiba Electromagnetic Flowmeters Model LF 654 detectors with LF 622 convertors, no equals allowed.

B. Flow meters shall be:

	Converter Model No.	Detector Model No.
8-inch meters	LF 622 FAC 211E	LF 654 LBCFCCAAB
14-inch meters	LF 622 FAC 211E	LF 654 PBCFCCAAB

- C. Meters shall be teflon lined with 316 stainless steel grounding rings, and Hastelloy C electrodes.
- D. Meters shall be isophthalic acid resin coated.
- E. Meter signal converter shall be provided a 100 VAC-240 VAC, 50 Hz/60 Hz power supply.
- F. Converter and detector shall be separate units with remote-mounted converter. Provide accessories for wall mounting converter.

## 2.11 MOTION DETECTORS

- A. The detector shall use passive infrared detection for detecting room occupancy. The unit shall fit on/in a standard box and shall require two wires and a grounded box for proper operation. Detector shall have gasketed, dust-proof, water-resistant, die-cast aluminum enclosure.
- B. Rated detector capacity shall be 10 mA at 12 VDC.
- C. Detector operating temperature shall be -40°F to 120°F and 10% to 90% humidity.
- D. Sensitivity shall be fully adjustable and shall include an on-delay timer with adjustable range of 2 to 5 seconds. Sensor shall also include a manual override for positive off and positive on with test LED to indicate motion.
- E. The sensor shall be equipped with special provisions, such as masking, to block out problem areas.
- F. Power to detector shall be from the associated SCC panel. Provide power supplies in the panel as required
- G. Ceiling-mount detectors shall be as manufactured by GE Security, Model AP669, or equal.

## 2.12 CARD ACCESS SYSTEM

- A. Card readers, programming, setup shall be provided by Innovative Systems, 9880 South Ridgeway Drive, Oak Creek, Wisconsin 53154, 1-800-750-7350. CONTRACTOR shall coordinate requirements with Innovative Systems. Existing control panel shall remain and new devices shall terminate in control panel.
- B. System supplier shall include an allowance of \$5,000 in the Lump Sum base bid to be adjusted at final payment in accordance with the actual charges for all equipment required for a complete and operating card access system. This includes additions to the existing control panel and control modifications to incorporate added devices.

## 2.13 VIDEO SURVEILLANCE SYSTEM

- A. Video cameras, enclosures, motion sensors, heaters, programming, and setup shall be provided by Replogix, Inc. 114 Parkview Drive Ext. Painted Post, New York, 1-800-437-5508 (Robert Lecher). Contractor shall coordinate requirements with Replogix. Existing control panel shall remain and new devices shall terminate in control panel.
- B. System supplier shall include an allowance of \$5,000 in the Lump Sum base bid to be adjusted at final payment in accordance with the actual charges for all equipment required for a complete and operating video surveillance system. This includes additions to the existing control panel and control modifications to incorporate added devices.

## 2.14 THERMAL MASS AIR FLOW METERS

- A. CONTRACTOR shall provide and install two thermal mass air flow meters where shown on the drawings. Meters shall be Model ST50 as manufactured by Fluid Components, Inc., San Marcos, CA; or equal. Units shall use temperature differential measurement techniques to infer air flow velocity and produce an output signal linearly proportional to flow rate. The systems shall include an insertion-type sensor, remote mounted electronics, and interconnecting cable.
- B. Meters shall be insertion type with the flow sensor probe/transmitter assembly inserted through and perpendicular to the flow and piping. The probes shall be inserted into the pipe via a 316 stainless steel compression fitting. A Vortab flow conditioner, Model VIP shall be provided for each meter.
- C. The flow sensors shall include a matched pair of platinum RTD elements and a low power heating element encapsulated in a 316 stainless steel thermowell rated for 500 psig.
- D. The transmitter shall provide a 4-20 mA DC output signal capable of driving into loads of 0 to 1,200 ohms without adjustment. Flow signal output shall be connected to the SCADA System for remote flow totalizing and flow rate indication. Flow measurement accuracy shall be 0.5% of full scale. Repeatability shall be 0.5% of reading. The transmitter shall be provided in a NEMA 4X enclosure and shall be located where shown on the drawings.
- E. Calibration and Testing: All flow sensors shall be factory calibrated for flow and temperature. Flow calibrations shall be traceable to the National Institute of Standards and Technology.
- F. The meter applications are as follows: Air Stripper No. 1 and Air Stripper No. 2: 12-inch-diameter ductile iron; 0-6,000 cfm flow rate.

## 2.15 SUBMERSIBLE DRAWDOWN TRANSDUCERS

- A. Provide new submersible pressure transducer to measure well pump drawdown levels. The transducer shall be designed for direct submergence in groundwater, surface water, salt water, or wastewater, and be as manufactured by Endress and Hauser, Water Pilot FMX21, Esterline, Model 300DS, or equal.
- B. The cable jacket shall be made of polyurethane and be compatible with groundwater, surface water, salt water, or wastewater.
- C. The nose cone shall be made of 316 stainless steel.

- D. Transducer Operating Specifications:
1. Excitation voltage: 10.5 to 35 Vdc.
  2. Output: 2-wire, 4-20mA.
  3. Compensated temperature range: 14° to 158°F.
  4. Electrical connection: Vented two conductor insulated polyurethane cable shielded with aluminum film, strain relief members, and pressure compensation tube with Teflon filter. Cable shall be approved for use in drinking water, and length shall be coordinated with depth and setting of the associated pump.
  5. Electronics:
    - a. Internally potted with molded cable.
    - b. Accuracy: Stainless steel,  $\pm 0.2\%$  of set span.
  6. Maximum Diameter: 0.87 inches.
  7. Range: 0 to 300 PSI, selected to meet project requirements.
  8. Overload Pressure: 580 PSI.
  9. Insulation Resistance: Less than 0.09 ohms per meter.
- E. Submersible pressure transducer shall have a ceramic measuring cell and an integral cable that contains a vent tube that references the sensor to atmospheric pressure. The molded polyurethane cable and internal potting in the transmitter shall prevent the ingress of water into the back of the transmitter. The vent tube shall be attached to the back of the sensing element, providing a gauge reference to atmosphere.
- F. Pressure transducers shall include a terminal enclosure with desiccant to prevent moisture ingress via the vent tube or cable conductors. Enclosure shall dry the air that breathes into the tube via vent opening with a 35 micron PTFE filter that prevents water ingress even during flood conditions. Enclosure shall meet the following requirements:
1. NEMA 4X rated.
  2. PVC base and clear Halogen-free self-extinguishing polycarbonate cover.
  3. Equipped with screw terminals and DIN rail mounted terminal blocks.
  4. Equipped with microfilter which prevents ingress of water.
  5. Equipped with desiccant module with sight gage for determining desiccant change intervals.

## 2.16 PRESSURE TRANSDUCERS

- A. Pressure transducers shall sense gauge or differential pressure and provide a 4-20 maDC signal proportional to the sensed pressure. The control system will provide 24 VDC loop power. Increasing pressure shall result in increasing signal.
- B. Transducers shall be suitable for use in ambient conditions of 0° to 180°F and 0% to 100% relative humidity.
- C. Accuracy (including linearity, hysteresis, and repeatability) shall be a minimum of  $\pm 0.10\%$  of span. Long-term drift shall be less than  $\pm 0.1\%$  of the upper range limit over a 12-month period. The transducer output signal shall not change more than 0.0005% of span for a 1V change in the loop voltage. Ambient temperature affect shall be less than  $\pm 0.6$  psi for a 10 to 300 psi transducer that experiences a 100°F change in ambient temperature within the normal operating range. Mounting position shall not affect transmitter performance. RFI effect shall be less than 0.1% of span for radio frequencies in the range of 27 to 1,000 MHz and field intensity of 30V/m.

- D. Process connection shall be 316L stainless steel fitting size and type as required by CONTRACTOR. Sensor material shall be 316L stainless steel, with silicone fill fluid. Sensor shall be suitable for use with process liquid/gas temperature from -50° to 250°F.
- E. Calibrated range shall be determined by CONTRACTOR based on process conditions. Calibrated range and process conditions used to determine range and span limits shall be included in submittal.
- F. Pressure transducer housing shall be NEMA 4X, epoxy-coated aluminum with a minimum of one 1/2-inch NPT conduit connection. Housing shall provide separation between electronics and field connections.
- G. Digital indicator with transducer configuration pushbuttons shall be provided in the transducer housing. Transducer configuration shall be performed using pushbuttons on the transducer. A Hart communicator or other electronic device **shall not** be required to configure the transducer.
- H. Transducer shall be direct-connected to process unless specified otherwise on the drawings. Provide stainless steel bracket and mounting bolts for surface mounting of transducer if wall mounting is specified. Provide stainless steel two-valve manifold for pressure transducers and stainless steel three-valve manifold with test ports for differential pressure transducers.
- I. Provide stainless steel information tag that indicates instrument number, service, and calibration range.
- J. Pressure transducers shall be Foxboro Model IGP20, ABB, or equal.

### PART 3-EXECUTION

#### 3.01 MADISON WELL NO. 15 MOTOR CONTROL CENTER (MCC-15 NOTES)

- A. Well Pump (WP-15-01)
  - 1. With the H-O-A selector switch in the "Hand" position the motor shall start and run at the speed set on the drive HIM, bypassing all controls unless noted otherwise. Hand position shall be hard-wired and not through the PLC.
  - 2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
  - 3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA system as described under SCC-15 below.
  - 4. Provide a hardwired two position selector switch (VFD-Bypass) on front of the VFD enclosure to allow the operator to select which starter will be used to operate the motor.
  - 5. Provide a hardwired backspin timer to prevent motor restart against backflow, adjustable from 0-10 minutes. Timer shall commence when motor is shutdown (Hand and Auto modes).
  - 6. Provide a time delay relay, adjustable 0-6 minutes to control the pre-lube solenoid (SV-15-01) and delay well pump start (solenoid is powered to close-fail open). Time delay relay shall control the pre-lube solenoid and delay well pump start in both "Hand" and "Auto" modes. Timer shall be hardwired and not through the PLC.
  - 7. Provide prelube flow switch (FS-15-01) to generate a pre-lube flow fail alarm. In the event the pre-lube solenoid (SV-15-01) is called to open and after an adjustable time

delay, the signal from the pre-lube flow switch is not detected, a pre-lube flow fail alarm shall be indicated at the VFD enclosure and the well pump shall shutdown. Manual reset shall be required to restart the pump.

8. There is a high sump water level switch associated with each Air Stripper (LS-15-04 and LS-15-06) that shall shutdown the pump if either switch is activated. Manual reset shall be required to restart the pump.
  9. There is a low pressure switch associated with each Air Stripper (PS-15-02 and PS-15-04) that shall shutdown the pump if either switch is activated. Manual reset shall be required to restart the pump.
  10. High-High, Restore and Low Level floats (LS-15-01, LS-15-02, and LS-15-03) shall be hardwired to the well pump and operate as described under SCC-15 below.
  11. Motor has internal thermal overloads that shall shut down the motor in the event of over-temperature (Hand and Auto modes). Manual reset shall be required to restart motor. Internal thermal overloads shall be wired so that momentary power interruptions do not shut down motor.
  12. There are receptacles for a chemical feed pump solenoid valve (SV-15-02) and another for a chemical feed pump. Each receptacle shall be interlocked with an auxiliary well pump motor run contact and limit switch (ZS-15-10) such that once the well pump is running and the limit switch is activated, the solenoid receptacle and feed pump receptacle shall be energized. This control shall be hardwired and not through the PLC. Power to receptacles shall be through the SCC via LP-15.
  13. The well pump check valve limit switch (ZS-15-10) shall control the pump such that in the event that a pump run signal is seen, and after a time delay, the signal from the check valve limit switch is not detected, a flow failure alarm shall be indicated at the SCC and the well pump shall shutdown. This control shall be hardwired and not through the PLC.
  14. There is an existing vibration sensor (VE-15-01) located on the existing well pump motor that shall be relocated to the new motor. Motor shall be shutdown if the vibration level reaches the vibration shutdown setpoint. Manual reset shall be required to restart the pump. Sensor shall be powered from control power transformer in VFD enclosure.
  15. Motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the "Off" position.
- B. Booster Pump (BP-15-01)
1. With the keyed H-O-A selector switch in the "Hand" position the motor shall start and run at the speed set on the drive HIM, bypassing all controls unless noted otherwise. Hand position shall be hard-wired and not through the PLC
  2. With the keyed H-O-A selector switch in the "Off" position, the motor shall be inoperable.
  3. With the keyed H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA system as described under SCC-15 below.
  4. Provide a hardwired three position selector switch (VFD-Auto-Bypass) on front of the VFD enclosure to allow the operator to select which mode of operation will be used to control the motor.
  5. Provide a hardwired backspin timer to prevent motor restart against backflow, adjustable from 0-10 minutes. Timer shall commence when motor is shutdown (Hand and Auto modes).
  6. The booster pump existing check valve limit switch (ZS-15-11) shall control the pump such that in the event that a pump run signal is seen, and after a time delay, the signal from the check valve limit switch is not detected, a flow failure alarm shall be indicated and the booster pump shall shutdown. This control shall be hardwired and not through the PLC.

7. High-High, Restore and Low Level floats (LS-15-01, LS-15-02, and LS-15-03) shall be hardwired to the booster pump and operate as described under SCC-15 below.
  8. Motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the "Off" position.
- C. Blower No. 1 and No. 2 (B-15-01 and B-15-02)
1. With the H-L-A-O selector switch in the "Hand" position the motor shall start and run at the speed set on the drive HIM, bypassing all controls unless noted otherwise. Hand position shall be hard-wired and not through the PLC
  2. With the H-L-A-O selector switch in the "Local" position, the motor shall be controlled as follows:
    - a. Blowers shall be interlocked to run with the Well Pump (WP-15-01). Blower shall start and run at a constant speed. When well pump is shutdown, the blower shall run for an operator adjustable time delay after the well pump is off (0 to 5 minutes).
    - b. Local speed shall be independent of the hand speed.
  3. With the H-L-A-O selector switch in the "Auto" position, the motor shall be controlled from the SCADA system as described under SCC-15 below.
  4. With the H-L-A-O selector switch in the "Off" position, the motor shall be inoperable
  5. There is a high sump water level switch associated with each Air Stripper (LS-15-04 and LS-15-06) that shall shutdown the blowers if the switch is activated. Manual reset shall be required to restart the blowers.
  6. There is a low pressure switch associated with the Air Strippers (PS-15-02 and PS-15-04) that shall shutdown the blowers if the switch is activated. Manual reset shall be required to restart the blowers.
  7. Motor has internal thermal overloads that shall shut down the motor in the event of over-temperature (Hand and Auto modes). Manual reset shall be required to restart motor. Internal thermal overloads shall be wired so that momentary power interruptions do not shut down motor.
  8. Motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the "Off" position.
- D. Well Pump (WP-15-01) Bypass Starter
1. 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 and not through the PLC.
  2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
  3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA system as described under SCC-15 below.
  4. All hardwired controls associated with the VFD shall be wired to the Bypass Starter.
- E. Booster Pump (BP-01-01) Bypass Starter
1. 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 and not through the PLC.
  2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
  3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA system as described under SCC-15 below.
  4. All hardwired controls associated with the VFD shall be wired to the Bypass Starter.

- F. Treatment Room Exhaust Fan (EF-15-03)
  - 1. 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 and not through the PLC.
  - 2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
  - 3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from a room thermostat. Fan shall start when room temperature rises above the thermostat setpoint.
  - 4. Dampers shall open when fan is running. Provide extra capacity control power transformer for 120 volt power to associated dampers.
  - 5. Motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the "Off" position.

### 3.02 SUPERVISORY CONTROL CENTER (SCC-15)

- A. This control panel shall be a minimum of 30 inches wide by 20 inches deep by 90 inches high and be located in the MCC room of the Well 15 Building where shown on the drawings. This panel shall be used as a termination point for all transmitting and receiving equipment associated with MCC-15 and the Well 15 Building. All control algorithms and alarms described herein shall be programmed into this PLC. Refer to the I/O listing for all required I/O that shall interface with this SCC. A minimum of 25% spares shall be provided for each type of input and output used.
- B. There is an existing spread spectrum MDS iNet 900 radio located in the existing radio telemetry enclosure that shall be reused and located to this enclosure. Radio should be powered from this SCC and a lightning arrestor shall be provided. The existing antenna and mast shall be reused and installed in location as shown on drawings.
- C. System Supplier shall include programming within this PLC as specified herein for equipment with PLC controls provided as specified in Division 11. This logic shall include generation of daily and cumulative totals, minimum, maximum, and average readings, and incorporation of alarms. System Supplier shall review the associated equipment and PLC logic provided by Division 11, and coordinate the required programming with the Division 11 supplier.
- D. Power supplies for radio installed in this panel shall be powered through a normally closed control power relay contact. In the event that the remote PLC detects a data fail with the master radio, the PLC shall energize the control power relay that will de-energize power to the radio. The relay shall be energized for five seconds and then de-energized. Data fail time delay shall be adjusted during start-up based on the quantity of remote telemetry panels.
- E. UPS installed in supervisory control center shall be provided as specified herein with a relay IO module that provides a dry contact output to the PLC in the event that the UPS batteries need replacement. Indication of "Replace UPS Battery" shall be provided at the SCADA system.
- F. SCC shall have an exterior panel-mounted receptacle and programming port for the Ethernet network, mounted to the front or side of the panel as applicable to the installation. Receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door. Programming port shall match that of the network (e.g., data highway, Ethernet, etc.).

- G. Control descriptions described herein are specific in nature to equipment associated with the SCC. CONTRACTOR shall refer to Section 1.12–General Control Algorithms for additional programming requirements. Control description described in Section 1.12 and this section shall reside in the local PLC and not in the master.
- H. Provide a new power fail relay in SCC that shall be used for control power fail alarm as well as indication that operation is from the UPS. Provide a white, 30mm, push-to-test indicating light on the front of the enclosure to indicate that power is being supplied by the UPS. Control power fail wiring shall be hard-wired and not through the PLC.
- I. There is a configurable network switch fail contact available from the network switch. This fail contact shall be wired to a relay, which shall be wired to the respective PLC for indication that its associated primary fiber loop has failed. Network switch shall be configured by System Supplier (via software) to provide this alarm.
- J. Provide nameplate or laminated sheet inside the SCC enclosure indicating which inputs correspond to which PLC LED; nameplate to be an engraved nameplate. See Section 16010-General Electric Requirements.
- K. In the event of a power failure at Well No. 15, when power is restored, the PLC shall automatically stagger the restart of any controlled equipment that is being called to run by the PLC. The stagger time shall be HMI adjustable from 0 to 300 seconds.
- L. Provide a Dell Optiplex 160, or equal computer inside the SCC enclosure. Computer shall be installed on stand. Provide a Hope, 17” touchscreen monitor, model HIS-ML17-STAE, or equal installed on the front door of the enclosure. Provide cabling as shown on the drawings. The touchscreen shall allow the operator to enter all control and alarm setpoints and shall be setup such that it prompts the operator for the setpoint to be entered. The touchscreen shall provide the following indication and operation functions for the system.
  - 1. Indication of all analog signals.
  - 2. Hand-Off-Auto (H-O-A) control for each piece of equipment controlled from this PLC.
  - 3. Adjustment for all setpoints.
  - 4. Indication of Master Station control mode.
  - 5. Running, failed, and required (where applicable) for each piece of equipment.
  - 6. Status of all equipment.
  - 7. Indication of all alarm conditions.
- M. Control functions and monitoring points as specified herein and identified in Section 16990 - I/O lists, shall be programmed into the operator interface panel in graphic form. The screens shall be as follows:
  - 1. The default screen shall be an overview of the system and shall show all analog values as well as run and fail indication of monitored equipment.
  - 8. There shall be control setpoint screens that will allow the operator to enter all system setpoints and select control modes for each piece of equipment. Associated analog values shall be indicated on these screens.
  - 9. There shall be an alarm summary that shall indicate the last 10 alarms, and indicated whether the alarm is active, unacknowledged, or returned to normal. The operator shall be able to acknowledge alarms from this screen. The current alarm shall blink until acknowledged. The alarms shall be in chronological order. Alarms shall not clear until manually reset individually.
  - 10. Provide trending screens for each analog value.

11. The above screens and are the minimum screens required. CONTRACTOR shall include an additional five screens in the Bid similar in size and complexity to those described above.
- N. System supplier shall include an allowance of \$15,000 for PLC and SCADA software improvements at the Master Station.
- O. The existing radio telemetry system shall be setup as a backup to the existing fiber optic network. The fiber optic network shall be the primary communication medium to the Master Station. If the fiber connection fails, the radio telemetry system shall automatically be placed in operation until the fiber network is restored.
- P. Madison Water Utility Well No. 15 control system shall consist of three operating control sequences. The control circuits shall be interlocked to prevent both start contacts (PLC and Backup Floats) from energizing the start circuit for the well and booster pump at the same time. Provide a three-position (Remote - Backup Floats – Off/Reset) selector switch on the front of this SCC. Indication of control mode shall be sent to the SCADA system. The selector switch shall allow the operator to manually select which control sequence is used to control the well and booster pumps. The well pump (WP-15-01) and Booster Pump (BP-15-01) each have VFD and Bypass starters. There are selector switches on each pump to select the starting means.
1. In the SCC “Remote” position, the operator shall have the ability to select an “On” mode or “Off” mode for the well facility from the Master Station. In the Master Station “Off” mode, the well and booster pumps shall be shut down. In the Master Station “On” mode, the well and booster pumps shall be controlled as follows:
    - a. With the VFD-Bypass selector switch for the well pump (WP-15-01) in the VFD position, the operator shall be able to select an “Auto” mode, “Operator Control” mode, or “Early Start” command from the Master Station. Control for each of these modes shall be as follows:
      - (1) In the Master Station “Auto” mode, the well pump shall be controlled based on well pump flow rate and interlocked with the submersible level transducer (LIT-15-01) and backup High-High Water Level (HHWL) (LS-15-01) float switch (hardwired) in the reservoir. The well pump VFD shall have a dual ramp startup programmed internal to the VFD. Ramp times shall be determined in the field at well pump start-up. The first ramp time shall allow the well pump to accelerate to a minimum speed in a specified time period. After this time has elapsed, the motor shall continue to accelerate over a second specified time until full speed is achieved. Once full speed is achieved, the PLC shall control the well pump as follows:
        - (a) The well pump speed shall be controlled based on an operator adjustable well pump flow rate setpoint.
        - (b) The well pump speed shall modulate to maintain the operator selected flow rate as monitored by the sum of the two flow meters (FIT-15-01 and FIT-15-02) on the well pump discharge lines.
        - (c) A separate minimum operating speed set point shall be provided to prevent the VFD from operating below the minimum speed set point. The minimum speed set point shall over ride the flow control set point.
        - (d) There shall be an operator adjustable High Water Level (HWL) alarm setpoint (LIT-15-01) within this PLC. In the event the water level in the reservoir rises above this HWL alarm setpoint, the well pump shall be shutdown and an alarm indicated at the OIP and Master Station. There shall also be an operator adjustable Well Pump Restore level setpoint

- within this PLC such that once the level in the reservoir drops below this setpoint the well pump shall be restarted.
- (e) In the event the reservoir water level rises above the HHWL float (LS-15-01), the well pump shall be shut down and a “Well Pump Shutdown – Reservoir HHWL Float” alarm indicated at the OIP and Master Station. This shutdown shall be hardwired and not through the PLC. In order to restart the well pump under this scenario, the operator shall be required to manually reset the controls or switch to the Backup Floats mode.
  - (f) There shall be an operator adjustable well pump flow meter flow differential set point within the PLC. In the event that the absolute value of the difference in instantaneous flow through the well pump flow meters (FIT-15-01 and FIT-15-02) exceeds the flow differential set point for an operator adjustable time delay, a well flow split differential alarm shall be generated at the OIP and Master Station. If either of the Air Strippers is Out of Service, this alarm shall be disabled.
- (2) In the Master Station “Operator Control” mode, the well pump shall cycle between the HWL and Restore level setpoints described above, under Master Station “Auto” mode, such that if the water level in the reservoir rises above the HWL alarm setpoint the well pump will be shut down until the water level in the reservoir drops below the Restore level setpoint at which time the well pump shall be restarted. In this mode, the HWL alarm shall be disabled and the operator shall manually set flow rate from the Master Station.
  - (3) The “Early Start” command shall function in the “Auto” mode or “Operator Control” mode. If initiated at the Master Station the well pump shall start prior to the level in the reservoir dropping below the Restore level setpoint or Restore float (LS-15-02). This operation assumes that the well pump was shutdown from the HWL alarm setpoint or HHWL (LS-15-01) float. If the pump was not shutdown, the early start command shall not be initiated. The well pump shall not be called to start from this command if the level in the reservoir is above either the HWL alarm setpoint or the HHWL (LS-15-01) float. Once the well pump is restarted it shall operate based on the control mode selected from the Master Station.
- b. With the VFD-Auto-Bypass selector switch for the booster pump (BP-15-01) in the Auto position, the operator shall be able to select an “Auto” mode, “Off” mode and “Operator Control” mode, for the booster pump from the Master Station. Control for each of these modes shall be as follows:
- (1) In the Master Station “Auto” mode, the booster pumps shall controlled as described below.
  - (2) In the Master Station “Off” mode, the booster pump shall be shutdown.
  - (3) In the Master Station “Operator Control” mode, the booster pump shall start and run at a constant speed set at the SCADA System until switched to the “Off” or “Auto” mode.
- c. In Master Station “Auto” mode, the booster pump (BP-15-01) shall be controlled from the system discharge flow meter (FIT-15-03), submersible level transducer (LIT-15-01) and backup Restore (LS-15-02) and Low-Low Water Level (LLWL) (LS-15-03) float switches in the reservoir. The PLC shall control the booster pumps as follows:
- (1) The booster pump speed shall be controlled based on an operator adjustable system flow meter discharge setpoint that is the flowrate to be maintained into the system. There shall be an operator adjustable deadband

and time delay for the flow rate setpoint such that the system flow rate must be outside the deadband for the time delay prior to a change in booster pump speed. This time delay shall function between each change in pump speed. The deadband and time delay shall be operator adjustable from the OIP.

- (a) There shall be an operator adjustable “Reservoir Low Level Warning” and “Booster Pump Shutdown” level setpoint within this PLC based on the level in the reservoir. In the event the water level in the reservoir drops below the Reservoir Low Level Warning setpoint, a “Reservoir Low Level Warning” shall be indicated at the OIP and Master Station and the booster pump modulated to maintain an operator adjustable Booster Pump Minimum Flow setpoint. There shall also be an operator adjustable “Booster Pump Restore” level setpoint within this PLC. The booster pump speed shall continue to maintain the Booster Pump Minimum Flow setpoint, until the Booster Pump Restore Level setpoint is reached or the booster pump is restarted. In the event the water level in the reservoir drops below the “Booster Pump Shutdown” level setpoint, the booster pump shall be shutdown. Once the level in the reservoir rises above the Booster Pump Restore level setpoint the booster pump shall be restarted.
  - (b) In the event the reservoir water level drops below the LLWL float (LS-15-03), the booster pump shall be shut down and a “Booster Pump Shutdown – Reservoir LLWL Float” alarm indicated at the OIP and Master Station. This shutdown shall be hardwired and not through the PLC. The booster pump shall be restarted automatically once the level in the reservoir rises above the backup Restore float switch (LS-15-02).
  - (c) In the event the LLWL float (LS-15-03) is activated, a blue indicating light located on the front of this SCC shall illuminate indicating the booster pump(s) are being controlled from the Backup floats.
2. In the SCC “Backup Floats” position, the well pump shall be controlled from the HHWL, and Restore backup floats in the reservoir. Provide a blue indicating light on the front of this SCC to indicate control is from the Backup Floats. Control from the backup floats shall be hardwired and not through the PLC. In this mode, the well pump shall be controlled as follows:
  - a. The well pump speed shall vary as described in the SCC “Remote” position. The well pump shall be started when the level in the reservoir drops below the Restore float (LS-15-02) and shall be shutdown when the level rises above the HHWL float (LS-15-01).
  - b. If initiated at the Master Station the well pump shall start prior to the level in the reservoir dropping below the Restore float (LS-15-02). This operation assumes that the well pump was shutdown from the HWL alarm setpoint or HHWL (LS-15-01) float. The well pump shall not be called to start from this command if the level in the reservoir is above the HHWL (LS-15-01) float. Once the well pump is restarted it shall operate based on the control mode selected from the Master Station.
  - c. In this mode of control the HHWL alarm shall be deactivated.
3. In the SCC “Off/Reset” position the well and booster pump shall shutdown.
4. In the event a reservoir hatch (ZS-15-08 and ZS-15-09) is opened and the entry alarm system has not been disabled as described below, the well and booster pumps shall be shutdown immediately.

- Q. Well Pump Bypass Starter Control: In the event a well pump VFD fault signal is seen at this PLC, an alarm shall be generated. With the VFD-Bypass selector switch in the Bypass Position, the RVSS Starter will be activated and the well pump shall be controlled as follows:
1. In the SCC “Remote” mode, the operator shall have the ability to select an “On” mode or “Off” mode for the well facility from the Master Station. In the Master Station “Off” mode, the well and booster pumps shall be shut down. In the Master Station “On” mode, the well pump shall be controlled as follows:
    - (1) In the “Operator Control” mode the well pump shall operate as described above.
    - (2) The operator shall be able to select an “Early Start” command at the Master Station. The “Early Start” command from the Master Station shall call for the well pump to start prior to the level in the reservoir dropping below the Restore level setpoint or Restore level float (LS-15-02). This operation assumes that the well pump was shutdown from the HWL alarm setpoint or HHWL float (LS-15-01). The well pump shall not be called to start from this command if the level in the reservoir is above either the HWL alarm setpoint or the HHWL float. Once the well pump is restarted it shall operate based on the control mode selected from the Master Station.
  2. In the SCC “Off/Reset” position the well pump shall shutdown.
  3. In the SCC “Backup Floats” mode the well pump shall be started when the level in the reservoir drops below the Restore float (LS-15-02) and shall be shutdown when the level rises above the HHWL float (LS-15-01). In this mode of control the HHWL alarm shall be deactivated.
- R. Booster Pump Bypass Starter Control: In the event a booster pump VFD fault signal is seen at this PLC, an alarm shall be generated. There shall be a “VFD-AUTO-BYPASS” switch on the face of the Booster Pump VFD. When in the “VFD” position, the pump shall remain off until such time the VFD fault is cleared and the pump returned to service. When in the “AUTO” position, the Booster Pump shall automatically transfer to the Booster Pump Bypass Control as described above. When in the “BYPASS” position, the Booster Pump Control shall be as described below:
1. The operator shall be able to select, or have already selected, an “Auto” mode, “Off” mode and “Operator Control” mode, for the booster pump from the Master Station.
    - a. In the Master Station “Auto” mode, the booster pumps shall run. There shall be an operator adjustable “Booster Pump Shutdown” level setpoint within this PLC based on the level in the reservoir. In the event the water level in the reservoir drops below this setpoint, the booster pump shall be shutdown. There shall also be an operator adjustable “Booster Pump Restore” level setpoint within this PLC such that once the level in the reservoir rises above this setpoint the booster pump shall be restarted.
    - b. In the event the reservoir water level drops below the LLWL float (LS-15-03), the booster pump shall be shut down and a “Booster Pump Shutdown – Reservoir LLWL Float” alarm indicated at the OIP and Master Station. This shutdown shall be hardwired and not through the PLC. The booster pump shall be restarted automatically once the level in the reservoir rises above the backup Restore float switch (LS-15-02).
    - c. In the event the LLWL float (LS-15-03) is activated, A blue indicator located on the front of this PLC shall illuminate indicating the booster pump is being controlled off of the Backup floats and labeled such.
    - d. In the Master Station “Off” mode, the booster pump shall be shutdown.

- e. In the Master Station "Operator Control" mode, the booster pump shall start and run at constant speed until switched to the "Off" or "Auto" mode.
  - f. The booster pump shall stay in the Bypass Mode, until such time the fault is cleared and the switch is placed in the "AUTO" or "VFD" position.
- S. Blower Control (B-15-01 and B-15-02): There shall be a four position, "BLOWER 1-BLOWER 2- BOTH-OFF" selector switch on the front of the SCC. In the "BLOWER 1" position, only B-15-01 shall operate. In the "BLOWER 2" position, only B-15-02 shall operate. In "Both" both B-15-01 and B-15-02 shall operated. In the "OFF" position both blowers shall be shut down.
1. When selected to operate (BLOWER 1, BLOWER 2 or BOTH), blower(s) (B-15-01 and/or B-15-02) shall start and accelerate up to full speed upon a well pump start signal. There shall be an operator adjustable air flow rate set point. After an operator adjustable delay timer, the VFD shall modulate each blowers speed to maintain the air flow set point as monitored by the air flow meter (FIT-15-04 and/or FIT-15-05) associated with the respective blower. Blower(s) shall continue to run for an operator adjustable time period following the well pump shut down. The well pump shall not be permitted to restart until this time delay has expired.
  2. There are high pressure and low pressure switches (PS-15-01, PS-15-02, PS-15-03 and PS-15-04) associated with each Air Stripper. When a blower is selected for operation, running, and the delay timer referenced in paragraph 1 expires, and the sump pressure in the respective air stripper exceeds the high pressure switch set point (PS-15-01 and/or PS-15-03), a high sump pressure alarm shall be generated and the well pump shall shut down. The alarm shall designate which air stripper, "Air Stripper 1" or "Air Stripper 2", the alarm is associated with. The blower shall continue to run for an adjustable time period following the well pump shut down. The well pump shall not be permitted to restart until this time delay has expired.
  3. When a blower is selected for operation, running, and the delay timer referenced in paragraph 1 expired, and the discharge pressure in the respective air stripper is less than the low pressure switch set point(PS-15-02 and/or PS-15-04), a low pressure alarm shall be generated and the well pump shall shut down. The alarm shall designate which air stripper, "Air Stripper 1" or "Air Stripper 2" , the alarm is associated with. The blower shall continue to run for an adjustable time period following the well pump shut down. The well pump shall not be permitted to restart until this time delay has expired.
  4. When a blower is selected for operation, running, and the delay timer referenced in paragraph 1 is expired, and the water level in the respective air stripper is exceeds the high level warning float switch (LS-15-04 and/or LS-15-06), a high sump water level warning alarm shall be generated.
  5. When a blower is selected for operation, running, and the delay timer referenced in paragraph 1 is expired, and the water level in the respective air stripper exceeds the high level float switch (LS-15-04 and/or LS-15-06), a high sump water level alarm shall be generated and the well pump shall shut down. The alarm shall designate which air stripper, "Air Stripper 1" or "Air Stripper 2" , the alarm is associated with. The blower shall continue to run for an adjustable time period following the well pump shut down. The well pump shall not be permitted to restart until this time delay has expired.
  6. A differential pressure switch (PS-15-05 and PS-15-06) shall monitor the air pressure down stream of the filter on the blower intake. When the differential pressure switch closes, a dirty filter alarm shall be generated.
  7. A pressure indicator/transmitter (PDIT-15-01 and PDIT-15-02) shall monitor stripper sump pressure. There shall be an operator adjustable high pressure warning set point and a low pressure warning set point. These points shall be set below or above the

- associated high and low pressure switch set points. When the pressure exceeds the high pressure sump set point a stripper high sump pressure warning shall be generated. When the pressure drops below the low pressure sump set point a stripper low pressure warning shall be generated. The system shall remain in service. The alarms shall designate which stripper it is associated with.
8. Water flow meters (FIT-15-01, FIT-15-02) shall be provided for each stripper. There shall be an operator adjustable low and high flow warning set point. If the flow rate for either meter drops below, or exceeds the associated set point, a high or low flow warning shall be generated. The system shall remain in service.
  9. Air flow meters (FIT-15-04, FIT-15-05) shall be provided for each air stripper. There shall be an operator adjustable low and high flow warning set point. If the flow rate for either meter drops below, or exceeds the associated set point, a high or low air flow warning shall be generated. The system shall remain in service.
  10. High and low pressure switches, and high sump level float switches shall be provided with delay timers to prevent nuisance alarms.
  11. When the well pump bypass starter control is in effect and the four position switch is in either the "BLOWER 1" or "BLOWER 2" position, the well pump shall be locked out and prevented from starting. An alarm stating, "WARNING: TWO AIR STRIPPERS MUST BE IN SERVICE TO OPERATE IN WELL BYPASS STARTER MODE" shall be displayed locally and at the Master Station.
- T. Chemical Room Exhaust Fan (EF-15-02) shall be controlled from an HOA selector switch on this SCC, control stations (CS-15-03 and CS-15-04) and door switch (ZS-15-05) as follows.
1. In the "Hand" position, the fan shall run continuously, bypassing all controls unless noted otherwise.
  2. In the "Off" position, the fan shall be inoperable.
  3. In the "Auto" position, the fan shall be controlled from control stations at the room door (CS-15-03, AND CS-15-04), room door switches (ZS-15-05 and ZS-15-12), and from a PLC-based repeat cycle timer.
    - a. The fan shall be started from either control station start (pushbutton or selector switch) or by the room door switches. Once started, the fan shall run for an operator adjustable run time (0-30 minutes). The fan shall be shut down once the run time expires or by either control station stop pushbutton or selector switch.
    - b. There shall be an operator adjustable repeat cycle timer with setpoints for On-time (0-10 minutes) and Off-time (0-240 minutes), which shall cycle the fan when the room is not occupied. If the fan is started from a control station or door switch, the repeat cycle timer shall be reset and its cycle restarted once the fan is shut down from the stop pushbuttons or the run timer.
    - c. There is a low temperature thermostat (TS-15-02) installed in the chemical room that shall shut down the fan whenever the room temperature drops below the thermostat setting (SCADA Hand and Auto modes).
  4. Exhaust fan and dampers shall be powered from LP-15 through a 20 amp, single pole power relay and current switch in this SCC.
  5. Dampers shall open whenever fan is running.
  6. Exhaust fan shall be interlocked with the emergency pushbutton (CS-15-01) such that when the pushbutton is pressed, the fan shall shutdown. The fan shall remain shutdown until the pushbutton is reset.
  7. All controls shall be hardwired and not through the PLC.
- U. Provide new motion sensors and door limit switches, as specified herein and as shown on drawings for intrusion alarm indication at this SCC and Master Station. The motion sensors

shall be located such that the area covered includes all doors and windows within the space. The existing card reader access system shall operate in conjunction with the motion sensors and door switches such that a building entry alarm shall be generated at this SCC and the Master Station if a motion sensor or door switch is activated and a valid card access has not been received from the card reader access system. If a valid card access is received at this PLC within an adjustable time period, the motion sensors and door switches shall be deactivated for an operator adjustable time period. The operator shall be able to disable/enable the building entry alarm system from this SCC or from a command from the Master Station. A time-of-day timeclock shall also be provided in this PLC that will allow the operators to set activation and deactivation times for the entry alarm system based on the time of day.

- V. There is an existing Chlorine Leak Monitor located in the pump room. The leak monitor shall be monitored at this SCC. In the event the chlorine leak monitor is activated by either the manual pushbutton (CS-15-05) outside the Chemical room or the leak detector, the PLC shall activate the existing alarm light, new alarm light and horn on the exterior of the building and generate an alarm at this SCC and the Master Station. The chlorine leak alarm horn shall be silenced from this SCC or the master station. Strobe shall be rotating 360 degrees; 520,000 candlepower, 165 effective candlepower, 75 revolutions per minute with 120V power, red lines in a NEMA 4X enclosure. as manufactured by Edwards Signal model 52R-N5-40WH with wall mounting bracket WBR. Horn shall be Selectone model 300GCX-120 Horn and Selecton Universal tone module as manufactured by federal signal as well as required mounting hardware. Tone shall be set to whoop. Horn and strobes shall be powered from this SCC and fused. Warning sign to be installed by OWNER.
- W. There shall be operator adjustable high and low distribution system pressure alarm setpoints within this PLC based on the system pressure.
- X. There shall be operator adjustable low level alarm setpoint within this PLC based on the level in the reservoir.
- Y. The High and Low Vacuum Switches (VS-15-01 and VS-15-02) shall be monitored at this SCC, when the well pump is in operation. In the event either switch is activated, a Chlorine Feed Failure alarm shall be generated at this PLC.
- Z. Utilize existing scales for indication of chlorine gas and fluoride weight at the Control System. The amount of chlorine gas and fluoride used in a 24-hour period shall be totalized within this PLC for indication at the SCADA System. The 24-hour period for totalization shall be operator adjustable. When a chlorine gas and fluoride drum is filled, the PLC shall store the amount of chemical used up to that point and then begin to accumulate a new total. At the end of the 24-hour data gathering period, the two accumulated weights for each chemical shall be added together for a total usage over that 24-hour period. There shall be operator adjustable high and low usage alarms set up within this PLC for each chemical such that if the usage is above/below these setpoints in a given time period, an alarm is given at the SCADA System.
- AA. For power meter, provide indication of instantaneous kW, peak kW demand, and kWh used. The peak kW demand reading shall be a 15 minute rolling average demand reading as well as 15 minute rolling average demand reading for the current month. The peak kW demand reading for the current month and two previous months shall be displayed at SCADA, and the current reading shall reset on the first day of each month at the totalizer reset hour and minute. The kWh used shall be a daily total as well as a monthly total that

also resets on the first day of the month, at the totalizer reset hour and minute. The current and two previous months shall also be displayed.

- BB. For each pump, provide indication of instantaneous GPM/kW, daily and monthly kWh/kGal, and monthly runtime. The instantaneous readings shall utilize the GPM and the pump kW, and the daily and monthly readings shall utilize the total kGAL and total daily kWh. For the monthly calculation, the PLC shall store the current and two previous month's flow runtime, and kWh for display at SCADA.
- CC. In addition to the kW demand and kWh readings described previously, the PLC shall calculate the sum of the kW demand and kWh readings to provide an overall station peak kW demand and kWh reading. This shall include the current and two previous months.
- DD. Provide red alarm pilot light on front of this SCC for High Sump Level (FS-15-03) and Low Blower Pressure (PS-15-05 and PS-15-06). Provide time delay (0-30 seconds) for each switch to avoid nuisance tripping.
- EE. There shall be 2 circuits wired to this SCC to provide dedicated power to the following:
  - 1. Circuit 2—Supervisory controls.
  - 2. Circuit 25—Alarm light and horn.

END OF SECTION

## SECTION 16949

### SHORT CIRCUIT, COORDINATION, AND ARC FLASH HAZARD STUDY

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work included:
  - 1. CONTRACTOR shall retain the services of an independent third party firm to perform a short circuit, coordination, and arc flash hazard study as specified herein. The studies shall be submitted to ENGINEER prior to receiving final approval of the equipment shop drawings and prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval from ENGINEER may be obtained with a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.
  - 2. The studies shall include all portions of the new electrical distribution equipment from the service entrance down to and including each Motor Control Center, power panel and lighting panel. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

##### 1.02 REFERENCES

- A. NFPA70—National Electrical Code.
- B. NFPA70E—Standard for Electrical Safety in the Workplace, Latest Edition.
- C. IEEE Standard 1584—IEEE Guide for Performing Arc Flash Hazard Calculations.
- D. OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S.
- E. ANSI/IEEE Standards C37, 242, and 399.
- F. UL 489—Underwriter's Laboratories.

##### 1.03 QUALITY ASSURANCE

- A. The firm shall be currently involved in high- and low-voltage power system evaluation. The study shall be performed, stamped, and signed by a registered professional engineer in the State where the project is located. Credentials of the individual(s) performing the study and background of the firm shall be submitted to ENGINEER for review prior to start of the work. A minimum of five years experience in power system analysis shall be required for the project manager.
- B. The firm performing the study shall demonstrate capability and experience to provide assistance during start up as required.

##### 1.04 SUBMITTALS

- A. A preliminary submittal shall be provided prior to equipment shop drawing submittals and prior to commencement of short circuit, coordination, and arc flash hazard studies. The

preliminary submittal shall include qualifications of individuals who will perform the work, specific software and analysis tools that will be utilized, and example studies and reports completed for previous projects.

- B. Upon approval of the preliminary submittal, the studies shall be prepared and completed based on final approved shop drawings for all equipment specified in Division 16. The results of the studies shall be summarized in a final report and meet the following requirements.
1. Submit six bound copies of the final report, with two copies in PDF format, burned to compact disc. The two CDs shall also include all report files in Word format, one-line diagrams in PDF format, and all power analysis software files and associated libraries.
  2. Organize and submit the report with the following sections. Below are minimum requirements, and the report shall be tailored to meet specific project requirements and equipment.
    - a. Part I—Overview.
    - b. Part II—Short Circuit Study:
      - (1) Purpose.
      - (2) Explanation of data.
      - (3) Assumptions.
      - (4) General and specific procedures followed.
      - (5) Analysis of results.
      - (6) Recommendations.
      - (7) Fault Analysis Input Report.
    - c. Part III—Coordination Study:
      - (1) Purpose.
      - (2) Explanation of data.
      - (3) Assumptions.
      - (4) General and specific procedures followed.
      - (5) Analysis of results.
      - (6) Recommendations, including trip curves and device settings for project-specific equipment.
      - (7) Spreadsheet or report showing the range of all device settings and recommended settings.
    - d. Part IV—Arc Flash Study:
      - (1) Purpose.
      - (2) Explanation of Data.
      - (3) Assumptions.
      - (4) Analysis of results, including all items in Motor Control Centers, control panels, disconnects, etc.
      - (5) General and specific procedures followed.
      - (6) Recommendations, including system modifications that may reduce arc flash hazard based on analysis of results.
      - (7) Arc flash evaluation report including sample labels for major distribution equipment.
    - e. Appendices:
      - (1) One-line diagrams of the system in similar format as the Contract documents.
      - (2) One-line diagrams generated from the power analysis software showing project specific equipment, wire and cable types and lengths, fault currents, and recommended device settings.
      - (3) Protective device summaries generated by the power analysis software.
      - (4) Reference data.

(5) Paper copy of warning labels to be provided for the project.

C. Refer to Part 3–Execution for additional requirements and specific analyses to be performed.

## PART 2–PRODUCTS

### 2.01 POWER ANALYSIS SOFTWARE

A. The study and assessment shall be performed based on SKM PowerTools software utilizing Dapper, Captor, Arc Fault, and Arc Flash evaluation modules. Equivalent or alternative software packages may be used but shall be submitted for approval by ENGINEER as part of the preliminary submittal.

### 2.02 ARC FLASH HAZARD LABELS

A. Labels shall be provided for equipment specified in all Division 16 technical sections, as well as for equipment provided in Divisions 2, 5, 8, 11, 14, and 15 where an arc flash hazard may exist. Labels shall be as manufactured by Conney Safety products, or equal, and meet the following minimum requirements.

1. Self-adhesive, vinyl, 6 inches by 4 inches minimum.
2. Equipment identification, corresponding to the Contract documents.
3. Study date.
4. Arc-flash boundary.
5. Flash-hazard boundary.
6. Flash hazard category (0-4).
7. Shock hazard boundaries (limited approach and restricted approach).
8. Minimum arc rating (cal/cm<sup>2</sup>).
9. Personal Protective Equipment (PPE) level.
10. Required PPE.

### 2.03 ONE-LINE DIAGRAM

A. In each electrical room, provide a one-line diagram meeting the requirements of IEEE/ANSI Standard 141, mounted on a 24-inch by 36-inch minimum Styrofoam backboard.

## PART 3-EXECUTION

### 3.01 DATA COLLECTION

A. CONTRACTOR shall provide the required data to the firm for preparation of the studies. Firm performing the system studies shall furnish CONTRACTOR with a listing of the required data immediately after award of the Contract.

B. CONTRACTOR shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture. The following minimum information shall be collected and used.

1. Available fault current from the local utility company.

2. If applicable, existing equipment ratings, including bus bracing, interrupting device ratings, and age/condition.
3. Installed cable or busway lengths, along with the specific rating, type and manufacturer.

### 3.02 SHORT CIRCUIT AND COORDINATION STUDY

- A. Include in the appropriate report sections noted above, calculation methods and assumptions, base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculations shall be provided for multiple distribution system scenarios when source equipment can provide multiple power feeds to downstream equipment (i.e. standby generators, etc.).
- B. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each bus (each change of impedance), at each transformer primary and secondary terminals (new and existing), Motor Control Center, as well as other significant locations throughout the system including all three phase motors. Provide a ground fault current study for the same system areas (new and existing), including the associated zero sequence impedance data. Include in tabulations, fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault currents.
- C. In the protective device coordination study, provide time-current curves graphically for new and existing distribution equipment, indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
- D. Include on the curve sheets power company relay and fuse characteristics, system pertinent transformer characteristics, and characteristics of other system load protective devices. Include at least all devices down to largest three feeder circuit breakers in each new and existing switchboard.
- E. Include all adjustable settings for new and existing ground fault protective devices. Include manufacturing tolerance and damage bands in plotted circuit breaker characteristics. Show transformer full load and 150, 400, or 600% currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.
- F. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58% of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16% current margin to provide proper coordination and protection in the event of secondary line-to-line faults.

- G. Include complete fault calculations as specified herein for each proposed and ultimate source combination for both new and existing equipment. Note that source combinations may include present and future supply circuits, large motors, as noted on one-lines.
- H. Utilize equipment load data for the study obtained by CONTRACTOR from Contract documents, including contract addendums issued prior to bid opening.
- I. Include fault contribution of all motors in the study. Notify ENGINEER in writing of circuit protective devices not properly rated for fault conditions. Provide recommended settings for motor starters and note any system inadequacies or potentially hazardous conditions. Show each MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current to ensure protective devices will not trip major or group operation.

### 3.03 ARC FLASH HAZARD STUDY

- A. As part of the short circuit and coordination study, the arc flash hazard study shall be included. Include in the appropriate report sections noted above, the following minimum requirements:
  - 1. Determine and document all possible utility sources and scenarios that are capable of being connected to each piece of electrical gear. Calculations shall be based on highest possible source connection.
  - 2. Arc flash values for two normal cases to define the highest values (low short circuit and high short circuit).
  - 3. Arc flash values for two maintenance cases, which define the arc flash values available at the equipment that would be available if the instantaneous trip of the upstream circuit breaker is set at a minimum value. This is recommended for personnel working on live equipment.
  - 4. Recommendations to reduce the arc flash incident energy in all areas that require Class 2 and higher PPE.
  - 5. Calculations to conform to National Fire Protection Association (NFPA) 70E calculation standards. All incident energy units shall be calculated in calories per square centimeter.
- B. Furnish and install labeling as specified herein based upon the results of the arc flash hazard study.

### 3.04 FIELD SETTINGS

- A. CONTRACTOR shall perform field adjustments of the new and existing protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, coordination study, and arc flash hazard study.
- B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by CONTRACTOR at no additional cost to OWNER.

END OF SECTION

## SECTION 16951

### SPARE PARTS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Spare parts for applicable sections of Division 16, as noted below.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. 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.
- B. NEMA/ANSI Compliance: Comply with National Electrical Manufacturer's Association, American National Standards Institute, and other standards pertaining to material, construction, and testing where applicable.

##### 1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All electrical equipment and material shall be received and stored with the factory winterproof wrapping intact. Provide factory-wrapped waterproof flexible barrier metal for factory packaging of equipment and material to protect against physical damage in transit. When applicable, equipment stored shall be in factory coverings in a clean, dry, indoor space which provides protection against the weather.
- B. All spare parts shall be suitably boxed or wrapped to prevent deterioration and shall be completely identified on the outside.

#### PART 2–PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Spare parts specified herein shall be provided by the manufacturer listed in the section where the equipment is specified.

##### 2.02 MOTOR CONTROL CENTERS

- A. The following shall be furnished:
  1. Two spare fuses for each type of control and current-limiting fuse provided.
  2. One set of fuses for each VFD and Reduced Voltage Solid State Starter size (horsepower) provided.
  3. Twenty replacement lamps and lamp replacement tool for push-to-test indicating lights.
  4. One replacement relay for each type of relay provided, including time-delay relays.

5. Replacement contacts, along with all related springs, bolts, and other materials necessary to completely rebuild one line contactor of each type furnished.
6. One control power transformer for each size provided.

## 2.03 CONTROLS AND INSTRUMENTATION

- A. The following shall be furnished.
  1. 10% of PLC communication cards, minimum of one each. This shall include remote I/O scanner and adapter cards and PC cards as required.
  2. 10% of PLC input/output cards for each type provided (analog and discrete), minimum one each.
  3. Two transient/spike suppressors.

## PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

**SCADA SYSTEM I/O LISTING**

STRAND ASSOCIATES, INC.  
CITY OF MADISON - WELL NO. 15 VOC AIR STRIPPER  
CONTRACT 1-2012  
SCADA SYSTEM I/O LISTING - SCC-15

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
15	CONTROL POWER AVAILABLE		1	0	0	0	2-#14	FROM CONTROL POWER RELAY IN THIS SCC
15	MCC 3 PHASE POWER FAIL		1	0	0	0	2-#14	FROM PHASE MONITOR IN MCC
15	REPLACE UPS BATTERY		1	0	0	0	2-#14	FROM UPS IN THIS SCC
15	DATA FAIL		X	0	0	0	2-#14	FROM LOGIC WITHIN THIS PLC
15	PLC SCAN FAIL		X	0	0	0	2-#14	FROM LOGIC WITHIN THIS PLC
15	NETWORK SWITCH FAIL		1	0	0	0	2-#14	FROM NETWORK SWITCH IN THIS SCC
15	PLC LOW BATTERY		X	0	0	0		FROM LOGIC WITHIN THIS PLC
15	MCC-15 POWER METER							
15	VOLTAGE		0	0	X	0	ENET	FROM POWER METER IN MCC
15	CURRENT		0	0	X	0	ENET	FROM POWER METER IN MCC
15	KW		0	0	X	0	ENET	FROM POWER METER IN MCC
15	POWER FACTOR		0	0	X	0	ENET	FROM POWER METER IN MCC
15	KWH		0	0	X	0	ENET	FROM POWER METER IN MCC
15	KW DEMAND		0	0	X	0	ENET	FROM POWER METER IN MCC
15	EMERGENCY SHUTOFF PANEL ACTIVATED		1	0	0	0	2-#14	FROM EMERGENCY SHUTOFF PANEL IN CHEMICAL ROOM
15	WELL PUMP ROOM LOW TEMPERATURE	TS-15-01	1	0	0	0	2-#14	FROM EXISTING THERMOSTAT IN WELL PUMP ROOM
15	CHEMICAL ROOM LOW TEMPERATURE	TS-15-02	1	0	0	0	2-#14	FROM EXISTING THERMOSTAT IN CHEMICAL ROOM
15	CARD READER INTRUSION DISABLED		1	0	0	0	2-#14	FROM EXISTING CARD ACCESS CONTROL PANEL
15	WELL PUMP ROOM ENTRY	ZS-15-01	1	0	0	0	2-#14	FROM DOOR SWITCH
15	WELL PUMP ROOM ENTRY	ZS-15-02/03	1	0	0	0	2-#14	FROM DOOR SWITCH
15	CHEMICAL ROOM ENTRY	ZS-15-04	1	0	0	0	2-#14	FROM DOOR SWITCH
15	VOC REMOVAL ROOM ENTRY	ZS-15-05/06	1	0	0	0	2-#14	FROM DOOR SWITCH
15	MCC ROOM ENTRY	ZS-15-07	1	0	0	0	2-#14	FROM DOOR SWITCH
15	NORTH RESERVIOR HATCH ENTRY	ZS-15-08	1	0	0	0	2-#14	FROM LIMIT SWITCH AT HATCH
15	SOUTH RESERVIOR HATCH ENTRY	ZS-15-09	1	0	0	0	2-#14	FROM LIMIT SWITCH AT HATCH
15	VOC REMOVAL HATCH ENTRY	ZS-15-12	1	0	0	0	2-#14	FROM LIMIT SWITCH AT HATCH
15	VOC REMOVAL HATCH ENTRY	ZS-15-13	1	0	0	0	2-#14	FROM LIMIT SWITCH AT HATCH
15	WELL PUMP ROOM MOTION	MS-15-01	1	0	0	0	2-#14	FROM MOTION SENSOR IN WELL PUMP ROOM
15	VOC REMOVAL ROOM MOTION	MS-15-02	1	0	0	0	2-#14	FROM MOTION SENSOR IN VOC REMOVAL ROOM
15	MCC ROOM MOTION	MS-15-03	1	0	0	0	2-#14	FROM MOTION SENSOR IN MCC ROOM
15	WELLHOUSE ENTRY TO CARD ACCESS CONTROL PANEL		0	1	0	0	2-#14	TO EXISTING CARD ACCESS CONTROL PANEL
15	WELLHOUSE ENTRY TO VIDEO SURVEILLANCE CONTROL PANEL		0	1	0	0	2-#14	TO EXISTING VIDEO SURVEILLANCE CONTROL PANEL
15	CHLORINE SYSTEM							
15	CHLORINE LEAK WARNING (1 PPM)		1	0	0	0	2-#14	FROM EXISTING CHLORINE LEAK MONITOR IN WELL PUMP ROOM

STRAND ASSOCIATES, INC.  
CITY OF MADISON - WELL NO. 15 VOC AIR STRIPPER  
CONTRACT 1-2012  
SCADA SYSTEM I/O LISTING - SCC-15

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
15	CHLORINE LEAK MONITOR RESIDUAL		0	0	1	0	SH. PR	FROM EXISTING CHLORINE LEAK MONITOR IN WELL PUMP ROOM
15	CHLORINE LEAK HORN ON/OFF		0	1	0	0	2-#14	TO ALARM HORN OUTSIDE CHEMICAL ROOM
15	CHLORINE LEAK STROBE ON/OFF		0	1	0	0	2-#14	TO STROBE OUTSIDE CHEMICAL ROOM
15	CHLORINE LEAK STROBE ON/OFF		0	1	0	0	2-#14	TO EXISTING STROBE OUTSIDE PUMP ROOM
15	CHLORINE VENTILATION SHUTDOWN CONTROL STATION	CS-15-01	1	0	0	0	2-#14	FROM CONTROL STATION OUTSIDE CHEMICAL ROOM
15	CHLORINE ROOM EMERGENCY CONTROL STATION	CS-15-05	1	0	0	0	2-#14	FROM CONTROL STATION OUTSIDE CHEMICAL ROOM
15	CHLORINE WEIGHT (GALLONS)	WT-15-01	0	0	1	0	SH. PR	FROM EXISTING SCALE IN CHEMICAL ROOM
15	CHLORINE WEIGHT (GALLONS)	WT-15-02	0	0	1	0	SH. PR	FROM EXISTING SCALE IN CHEMICAL ROOM
15	CHLORINE RESIDUAL		0	0	1	0	SH. PR	FROM EXISTING CHLORINE ANALYZER IN PUMP ROOM
15	LOW VACUUM ALARM	VS-15-01	1	0	0	0	2-#14	FROM VACUUM SWITCH IN CHEMICAL ROOM
15	HIGH VACUUM ALARM	VS-15-02	1	0	0	0	2-#14	FROM VACUUM SWITCH IN CHEMICAL ROOM
15	FLUROIDE WEIGHT (GALLONS)	WT-15-03	0	0	1	0	SH. PR	FROM EXISTING SCALE IN CHEMICAL ROOM
15	FIRE SYSTEM TROUBLE		1	0	0	0	2-#14	FROM FIRE ALARM CONTROL PANEL
15	FIRE SYSTEM ALARM		1	0	0	0	2-#14	FROM FIRE ALARM CONTROL PANEL
15	FIRE SYSTEM SUPERVISORY SERVICE		1	0	0	0	2-#14	FROM FIRE ALARM CONTROL PANEL
15	PIT FLOOD	LS-15-08	1	0	0	0	2-#14	FROM EXISTING FLOAT SWITCH IN RESERVOIR PIT
15	WELL FLOW TO AIR STRIPPER NO. 1	FIT-15-01						
15	INSTANTENOUS FLOW		0	0	1	0	SH. PR	FROM MAGNETIC FLOW METER TRANSMITTER IN WELL PUMP ROOM
15	FLOW PULSE		1	0	0	0	2-#14	FROM MAGNETIC FLOW METER TRANSMITTER IN WELL PUMP ROOM
15	WELL FLOW TO AIR STRIPPER NO. 2	FIT-15-02						
15	INSTANTENOUS FLOW		0	0	1	0	SH. PR	FROM MAGNETIC FLOW METER TRANSMITTER IN WELL PUMP ROOM
15	FLOW PULSE		1	0	0	0	2-#14	FROM MAGNETIC FLOW METER TRANSMITTER IN WELL PUMP ROOM
15	STATION FLOW	FIT-15-03						
15	INSTANTENOUS FLOW		0	0	1	0	SH. PR	FROM MAGNETIC FLOW METER TRANSMITTER IN WELL PUMP ROOM
15	FLOW PULSE		1	0	0	0	2-#14	FROM MAGNETIC FLOW METER TRANSMITTER IN WELL PUMP ROOM
15	AIR STRIPPER NO. 1 AIR FLOW	FIT-15-04						
15	INSTANTENOUS FLOW		0	0	1	0	SH. PR	FROM THERMAL MASS AIR FLOW METER TRANSMITTER IN VOC REMOVAL ROOM

STRAND ASSOCIATES, INC.  
CITY OF MADISON - WELL NO. 15 VOC AIR STRIPPER  
CONTRACT 1-2012  
SCADA SYSTEM I/O LISTING - SCC-15

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
15	TOTAL FLOW		1	0	0	0	2-#14	FROM THERMAL MASS AIR FLOW METER TRANSMITTER IN VOC REMOVAL ROOM
15	AIR STRIPPER NO. 2 AIR FLOW	FIT-15-05						
15	INSTANTENOUS FLOW		0	0	1	0	SH. PR	FROM THERMAL MASS AIR FLOW METER TRANSMITTER IN VOC REMOVAL ROOM
15	TOTAL FLOW		1	0	0	0	2-#14	FROM THERMAL MASS AIR FLOW METER TRANSMITTER IN VOC REMOVAL ROOM
15	WELLHOUSE CONTROL SYSTEM							
15	REMOTE		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON SCC PANEL
15	BACKUP FLOATS		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON SCC PANEL
15	OFF/RESET		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON SCC PANEL
15	BOOSTER PUMP	BP-15-01						
15	IN AUTO		1	0	0	0	2-#14	FROM HOA SWITCH ON MCC
15	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
15	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC
15	MOTOR OVERTEMP		1	0	0	0	2-#14	FROM MOTOR THERMOSTATS/MCC
15	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
15	SPEED INDICATION		0	0	X	0	ENET	FROM VFD IN MCC
15	SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
15	KW		0	0	X	0	ENET	FROM VFD IN MCC
15	POWER AVAILABLE		0	0	X	0	ENET	FROM VFD IN MCC
15	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
15	FLOW FAIL	ZS-15-11	1	0	0	0	2-#14	FROM EXISTING CHECK VALVE LIMIT SWITCH
15	BOOSTER PUMP BYPASS STARTER	BP-15-01						
15	IN AUTO		1	0	0	0	2-#14	FROM BYPASS STARTER IN MCC
15	RUNNING		X	0	0	0	ENET	FROM BYPASS STARTER IN MCC
15	FAULT		1	0	0	0	2-#14	FROM MOTOR THERMOSTATS/MCC
15	START/STOP		0	X	0	0	ENET	TO STARTER IN MCC
15	WELL PUMP	WP-15-01						
15	REQUIRED		X	0	0	0	ENET	FROM VFD IN MCC
15	IN AUTO		1	0	0	0	2-#14	FROM HOA SWITCH ON MCC
15	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
15	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC
15	MOTOR OVERTEMP		1	0	0	0	2-#14	FROM MOTOR THERMOSTATS/MCC
15	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
15	SPEED INDICATION		0	0	X	0	ENET	FROM VFD IN MCC
15	SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
15	KW		0	0	X	0	ENET	FROM VFD IN MCC

STRAND ASSOCIATES, INC.  
 CITY OF MADISON - WELL NO. 15 VOC AIR STRIPPER  
 CONTRACT 1-2012  
 SCADA SYSTEM I/O LISTING - SCC-15

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
15	POWER AVAILABLE		0	0	X	0	ENET	FROM VFD IN MCC
15	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
15	PRELUBE FLOW FAIL	FS-15-01	1	0	0	0	2-#14	FROM PRELUBE FLOW SWITCH
15	FLOW FAIL	ZS-15-10	1	0	0	0	2-#14	FROM CHECK VALVE LIMIT SWITCH
15	VIBRATION ALARM	VE-15-01	1	0	0	0	2-#14	FROM EXISTING VIBRATION SENSOR AT WELL PUMP
15	VIBRATION LEVEL	VE-15-01	0	0	1	0	SH. PR	FROM EXISTING VIBRATION SENSOR AT WELL PUMP
15	DRAWDOWN LEVEL	LIT-15-02	0	0	1	0	SH. PR	FROM SUBMERSIBLE DRAWDOWN TRANSDUCER IN WELL
15	WELL PUMP BYPASS STARTER	WP-15-01						
15	IN AUTO		1	0	0	0	2-#14	FROM HOA SWITCH ON MCC
15	RUNNING		X	0	0	0	ENET	FROM BYPASS STARTER IN MCC
15	FAULT		X	0	0	0	ENET	FROM BYPASS STARTER IN MCC
15	MOTOR OVERTEMP		X	0	0	0	ENET	FROM MOTOR THERMOSTATS/MCC
15	START/STOP		0	X	0	0	ENET	TO BYPASS STARTER IN MCC
15	BLOWER CONTROL SYSTEM							
15	BLOWER 1		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON SCC PANEL
15	BLOWER 2		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON SCC PANEL
15	BOTH		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON SCC PANEL
15	OFF/RESET		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON SCC PANEL
15	BLOWER NO. 1	B-15-01						
15	IN AUTO		1	0	0	0	2-#14	FROM HOA SWITCH ON MCC
15	IN LOCAL		1	0	0	0	2-#14	FROM HOA SWITCH ON MCC
15	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
15	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC
15	MOTOR OVERTEMP		1	0	0	0	2-#14	FROM MOTOR THERMOSTATS/MCC
15	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
15	SPEED INDICATION		0	0	X	0	ENET	FROM VFD IN MCC
15	SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
15	KW		0	0	X	0	ENET	FROM VFD IN MCC
15	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
15	DIRTY FILTER	PS-15-05	1	0	0	0	2-#14	FROM PRESSURE SWITCH IN DUCTWORK AT BLOWER
15	BLOWER NO. 2	B-15-02	4	X	X	X		SAME AS B-15-01
15	AIR STRIPPER NO. 1							
15	HIGH PRESSURE	PS-15-01	1	0	0	0	2-#14	FROM PRESSURE SWITCH AT AIR STRIPPER
15	LOW PRESSURE	PS-15-02	1	0	0	0	2-#14	FROM PRESSURE SWITCH AT AIR STRIPPER
15	DIFFERENTIAL PRESSURE	PDIT-15-01	0	0	1	0	SH. PR	FROM DIFFERENTIAL PRESSURE TRANSDUCER AT AIR STRIPPER
15	HIGH LEVEL	LS-15-04	1	0	0	0	2-#14	FROM FLOAT SWITCH AT AIR STRIPPER
15	HIGH LEVEL SHUTDOWN	LS-15-05	1	0	0	0	2-#14	FROM FLOAT SWITCH AT AIR STRIPPER

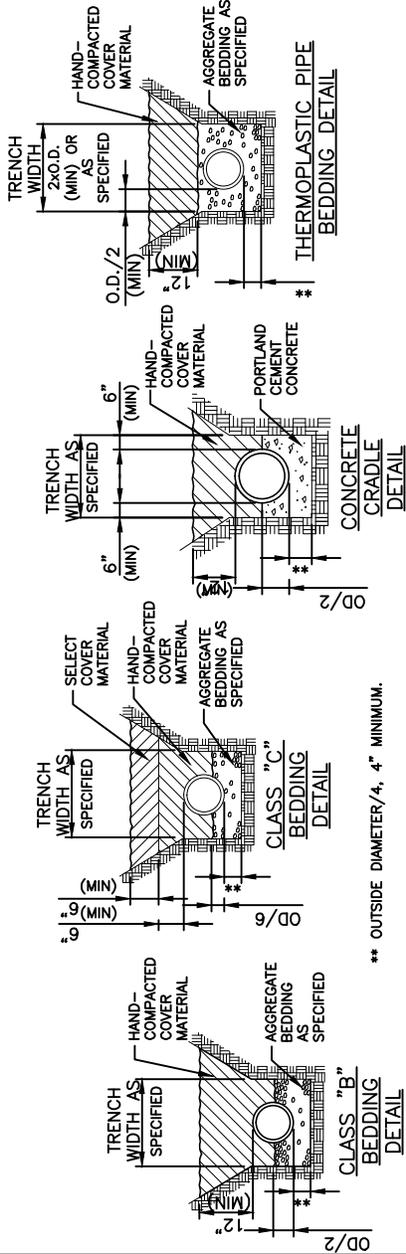
STRAND ASSOCIATES, INC.  
CITY OF MADISON - WELL NO. 15 VOC AIR STRIPPER  
CONTRACT 1-2012  
SCADA SYSTEM I/O LISTING - SCC-15

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
15	AIR STRIPPER NO. 2		4	0	1	0		SAME AS AIR STRIPPER NO. 1
15	RESERVOIR							
15	HIGH-HIGH LEVEL	LS-15-01	1	0	0	0	2-#14	FROM FLOAT SWITCH IN RESERVOIR
15	RESTORE	LS-15-02	1	0	0	0	2-#14	FROM FLOAT SWITCH IN RESERVOIR
15	LOW-LOW LEVEL	LS-15-03	1	0	0	0	2-#14	FROM FLOAT SWITCH IN RESERVOIR
15	LEVEL	LIT-15-01	0	0	1	0	SH. PR	FROM SUBMERSIBLE LEVEL TRANSDUCER IN RESERVOIR
15	SYSTEM DISCHARGE PRESSURE	PIT-15-01	0	0	1	0	SH. PR	FROM DISCHARGE PRESSURE TRANSDUCER IN WELL PUMP ROOM
15	CHEMICAL ROOM EXHAUST FAN	EF-15-02						
15	DOOR SWITCH ACTIVATED	ZS-15-04	1	0	0	0	2-#14	FROM DOOR SWITCH ON CHEMICAL ROOM EXTERIOR DOOR
15	START	CS-15-03	1	0	0	0	2-#14	FROM EXTERIOR CONTROL STATION AT CHEMICAL ROOM EXTERIOR DOOR
15	STOP	CS-15-03	1	0	0	0	2-#14	FROM EXTERIOR CONTROL STATION AT CHEMICAL ROOM EXTERIOR DOOR
15	RUNNING	CS-15-03	0	1	0	0	2-#14	TO EXTERIOR CONTROL STATION AT CHEMICAL ROOM EXTERIOR DOOR
15	START	CS-15-04	1	0	0	0	2-#14	FROM INTERIOR CONTROL STATION AT CHEMICAL ROOM EXTERIOR DOOR
15	STOP	CS-15-04	1	0	0	0	2-#14	FROM INTERIOR CONTROL STATION AT CHEMICAL ROOM EXTERIOR DOOR
15	IN AUTO		1	0	0	0	2-#14	FROM RELAY IN SCC
15	RUNNING		1	0	0	0	2-#14	FROM CURRENT SWITCH IN SCC
15	START/STOP		0	1	0	0	2-#14	FROM RELAY IN SCC
15	TREATMENT ROOM EXHAUST FAN	EF-15-03						
15	IN AUTO		1	0	0	0	2-#14	FROM HOA SWITCH ON MCC
15	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC
15	STARTER OVERLOAD		1	0	0	0	2-#14	TO STARTER IN MCC
15	START/STOP		0	1	0	0	2-#14	FROM STARTER IN MCC
15	EMERGENCY GENERATOR RUNNING (FUTURE)		1	0	0	0		
15	EMERGENCY GENERATOR FAIL (FUTURE)		1	0	0	0		
15	CHLORINE GAS FLOW (FUTURE)		0	0	1	0		
15	CHLORINE GAS FLOW CONTROL (FUTURE)		0	0	0	1		
15	FLUORIDE PUMP SPEED INDICATION (FUTURE)		0	0	1	0		
15	FLUORIDE PUMP SPEED CONTROL (FUTURE)		0	0	0	1		
15	RESERVOIR OVERFLOW (FUTURE)		1	0	0	0		
15	CHLORINE LEAK ALARM (3 PPM - FUTURE)		1	0	0	0		
	***TOTALS***		85	8	18	2		

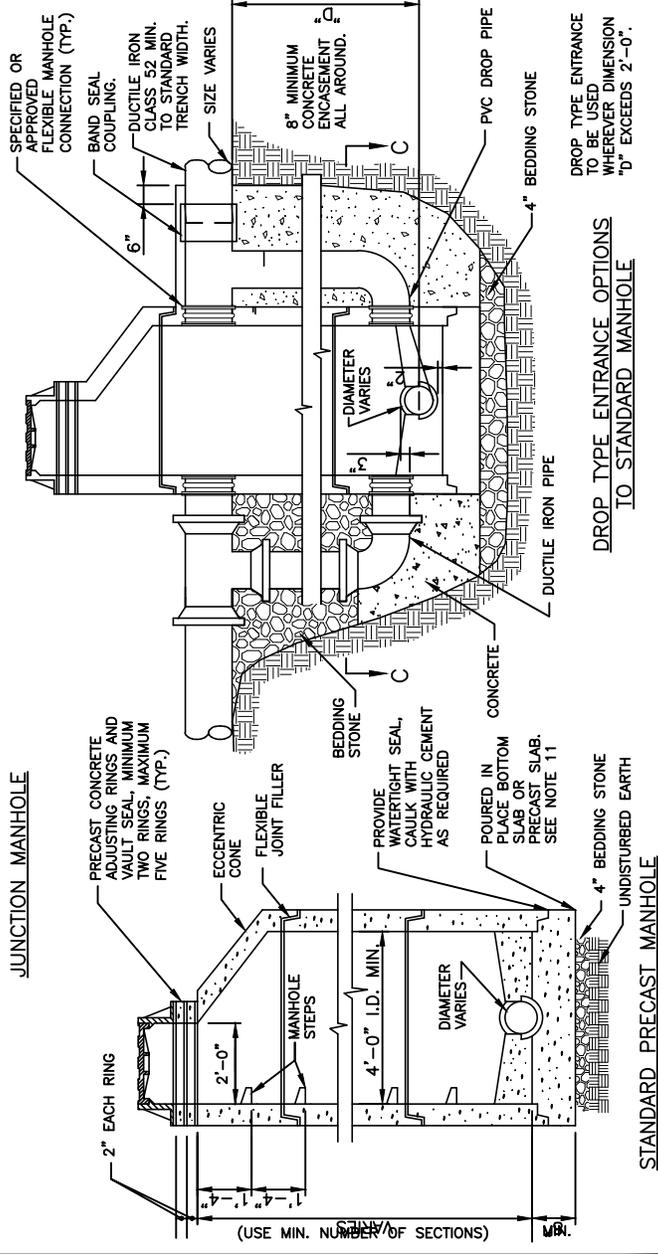
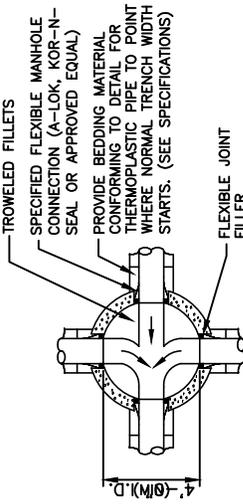
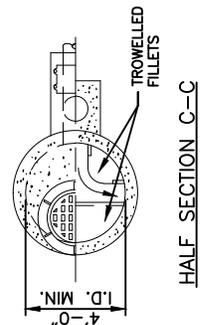
## **DRAWINGS**

**NOTES**

1. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
2. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSIBLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.
3. ALL CONCRETE FILLETS SHALL BE HAND TROWELED WITH A 1/4" FT. SLOPE.
4. INSIDE DIMENSIONS FOR MANHOLES: USE MINIMUM 4' DIAMETER FOR SEWER LESS THAN 18" IN DIAMETER; USE MINIMUM 5' DIAMETER FOR SEWER 18" THRU 24" IN DIAMETER; USE MINIMUM 6' DIAMETER OR MINIMUM 6' SQUARE FOR SEWER OVER 24" IN DIAMETER.
5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.
6. DROP TYPE ENTRANCE TO STANDARD MANHOLE WILL BE PAID FOR SEPARATELY IF SO LISTED IN THE BID.
7. SEE DRAWINGS FOR DROP TYPE ENTRANCES FOR SANITARY SEWERS LARGER THAN 15".
8. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.
9. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.
10. FLAT SLAB TOPS SHALL BE DESIGNED FOR H-20 TRUCK LOADING AND SHALL MEET REQUIREMENTS OF ASTM C-478.
11. BASE SLABS SHALL BE REINFORCED AS FOLLOWS: REINFORCING SHALL BE PLACED IN EACH DIRECTION AT 2" CLEAR FROM TOP SURFACE OF SLAB. REINFORCING SHALL BE GRADE 60. USE OF CAST-IN-PLACE SLAB SHALL NOT RELIEVE CONTRACTOR OF REQUIREMENTS TO PROVIDE WATERTIGHT JOINTS.
12. FLAT SLABS SHALL BE PROVIDED IN SHALLOW DEPTH SITUATIONS IN LIEU OF ECCENTRIC CONES.



\*\* OUTSIDE DIAMETER/4, 4" MINIMUM.



INSIDE DIA.	DEPTH	REINF.
4'	≤ 30"	#3@8"
5'	≤ 20"	#3@8"
5'	20'-30"	#4@10"
6'	≤ 20"	#4@10"
6'	20'-25"	#4@8"
6'	25'-30"	#4@6"

**SANITARY SEWER APPURTENANCES**

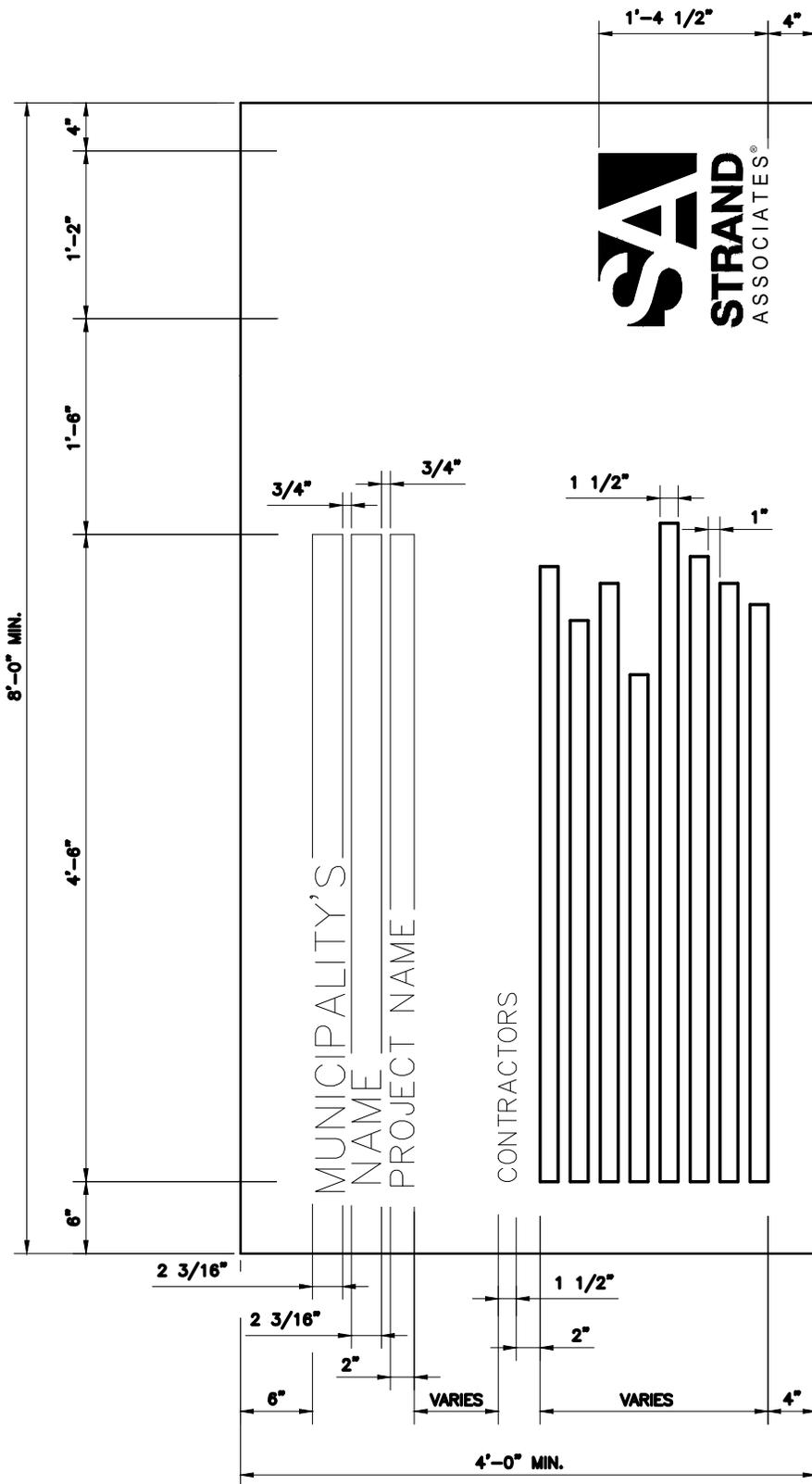
**STANDARD DETAIL**



01-975-43A

OCTOBER 2011





**NOTES:**  
 BLUELINE FOR LOGO WILL BE FURNISHED TO CONTRACTOR FOR SIGN PAINTING.  
 SEE SPECIFICATIONS FOR SIGN CONSTRUCTION DETAILS AND SPECIAL REQUIREMENTS  
 STANDARD COLORS ARE TO BE AS NOTED:  
 "SA" LOGO = SLATE GRAY  
 LETTERING = BLACK  
 BACKGROUND = WHITE

**PROJECT SIGN LAYOUT**

**STANDARD DETAIL**



01-975-158A

OCTOBER 2011

## **GEOTECHNICAL INVESTIGATION**



Construction • Geotechnical  
Consulting Engineering/Testing

April 25, 2012  
C12083

Mr. Al Larson  
Madison Water Utility  
119 East Olin Avenue  
Madison, WI 53713-1431

Re: Geotechnical Exploration  
Construction Testing Services  
Well No. 15 VOC Facility  
Madison, Wisconsin

Dear Al:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration program for the above-referenced project. The purpose of this program was to evaluate the subsurface conditions in the vicinity of the existing storage reservoir and to provide an opinion on whether the soils below the reservoir would be suitable for a higher bearing pressure as the result of constructing an addition above grade. We are sending you and Scott Herkert of Strand Associates an electronic copy of this report and can provide paper copies upon request.

### **PROJECT DESCRIPTION**

We understand that you have engaged Strand Associates to design an addition to the existing structure for removal of volatile organic compounds (VOCs). The proposed building addition will likely be constructed above the existing below-grade reservoir because of site constraints. The primary purpose of the exploration program was to determine the soil bearing capacity for the existing structure so that an assessment can be made as to whether it can accommodate the added loads from the new structure. We further understand that the soil cover above the existing reservoir may be removed and replaced with Geofoam to reduce the new loads, and then a new floor slab would be constructed at the same elevation as the existing well house. The new building will have masonry walls and precast roof extending about 14 ft above grade. A short section of the addition at its east end may extend beyond the limits of the existing reservoir and may be designed as a cantilever or supported on piers or footings.

### **SITE CONDITIONS**

Based on information obtained from the 1965 plans for the original project as provided to us by Strand, we understand the top of the base slab for the existing below-grade reservoir is generally at EL 873.5 to 874 ft, except for a deeper sump in one area. The roof is at about EL 888 ft and is covered with about 2.5 ft of soil. The floor slab in the well house section of the facility is at EL 890.67 ft, with the surrounding ground surface being at about EL 890 and falling off slightly away from the structure. We understand the base slab is about 12 to 18 in. thick, which puts the bearing elevation of the reservoir at EL 872 to 873, or about 17 to 18 ft below grade. A standby generator is located on the south side of the reservoir.

Mr. Al Larson  
Madison Water Utility  
April 25, 2012  
Page 2

## SUBSURFACE CONDITIONS

Subsurface conditions on site were explored by drilling two Standard Penetration Test (SPT) soil borings to depths of 40 ft below existing site grades. The locations were selected by CGC in consultation with Strand Associates. The borings were drilled on April 17, 2012 by Badger State Drilling (under subcontract to CGC) using a truck-mounted rotary drill rig equipped with hollow-stem augers and an automatic SPT hammer. The boring locations are shown in plan on the Soil Boring Location Map attached in Appendix B. Ground surface elevations at the boring locations were interpolated from a topographic map provided to us by Strand.

The subsurface profile at the boring locations is fairly consistent and can generally be described by the following strata (in descending order):

- 17 to 17.5 ft of **sand fill** or **possible fill**, consisting of brown fine to medium sand with some silt and gravel. The fill is interpreted as backfill against the existing reservoir and appears to be well compacted in Boring 2 below the paved area, but considerably looser (less well-compacted) in Boring 1 which is located in a landscaped area. The fill depth appears to correspond very closely with the bottom of the existing base slab for the reservoir.
- Underlying the fill or possible fill and extending to the maximum depth explored is a native, medium to very dense **sand** with some silt, gravel, and apparent cobbles and boulders. The native sand is similar in appearance to the sand fill but is consistently much denser than the overlying backfill. The stratum is a sandy glacial till commonly found in the Madison area.

Groundwater was not encountered in the borings during or after drilling. Although groundwater levels can be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration and other factors (including the pumping rate of Well No. 15), we do not anticipate that groundwater will be encountered within the excavation depths expected on this project. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B.

Note that there were no odors detected or other indications of potential contamination in the subsoils we sampled during the drilling program.

## DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion from a geotechnical point of view that the site is suitable for the proposed construction and that the bearing pressure can be increased on the existing structure to support the new VOC removal facility. Our recommendations for site preparation, foundation and floor slab design/construction are presented in the following subsections. Note that the recommendations in the following sections are based on our review of the geotechnical properties of the foundation and backfill soils and do not address the structural considerations involved in evaluating the feasibility of this project. We understand that Strand will be



Mr. Al Larson  
 Madison Water Utility  
 April 25, 2012  
 Page 3

addressing those issues. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

**1. Site Preparation and Floor Slab Support**

We concur with the proposed plans to remove the existing soil cover from above the reservoir and substitute lightweight Geofoam fill to re-establish floor grade. Removing about 2 ft of soil fill and replacing it with nearly weightless fill is estimated to reduce the load on the existing reservoir by about 200 psf. For normal floor slab loads, we recommend an EPS 12 Geofoam for this application. We can provide you with additional recommendations and refer you to several Geofoam suppliers if desired.

**2. Foundation Evaluation**

Based on the average SPT N-values in the native soils below the reservoir within 10 ft of the base elevation, it is our opinion that the allowable bearing capacity for the existing structure can be conservatively estimated as 7000 psf. As a result, from a geotechnical perspective, the VOC facility can be constructed above the existing reservoir. For a pressure increase of 500 to 1000 psf, we estimate the additional settlement will be less than 0.25 in.

We understand that the eastern section of the new VOC facility will extend beyond the reservoir and may be supported on a cantilevered section of floor. If this is not practical, the extended portion may be supported on piers or a foundation wall resting on spread footings. Unfortunately, the backfill against the east reservoir wall is apparently not well compacted, based on the relatively low SPT blow counts (3 to 8 blows/ft) in Boring 1, and we would be concerned about differential settlement between this portion of the structure if founded on shallow footings in the backfill and the part supported on the existing reservoir. While a very low bearing pressure could be considered for footings supported on the backfill, we recommend instead that piers be extended down to the native sand stratum at a depth of about 17 to 18 ft. If this option is selected, we recommend that the following parameters be used for foundation design:

- Maximum net allowable bearing pressure on native sand at about 17 ft below grade: 3,000 psf
- Minimum foundation widths:
  - Continuous wall footings: 18 in.
  - Column pad footings: 30 in.
- Minimum footing depth for frost protection: 4 ft

Note that the allowable bearing pressure for new, independent footings founded on the native soils near the base of the reservoir has been reduced from the 7000 psf value mentioned above to a reduced value of 3000 psf. The lower value is necessary to reduce the potential for differential settlement between the two parts of the structure. Undercutting below footing grade will be required if loose granular soils are observed at or below footing grade. 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 for each foot of undercut depth for stress

Mr. Al Larson  
Madison Water Utility  
April 25, 2012  
Page 4

distribution purposes. Grade can be restored using granular fill compacted to 95% compaction (ASTM D 1557) or compacted coarse stone (breaker run, select crushed material or 3-in. dense graded base course, as described in Appendix D).

As an alternative to reduce the extent of excavation, it may be practical to undercut the final 8 to 12 ft (or so) of loose, existing backfill and replace it immediately with lean mix concrete. Provided no one enters the excavation, it would not be necessary to fully slope the excavation back at stable OSHA slopes. The undercut excavation in this case would only need to be about 6 in. wider in each direction than the base of the footing, in each direction, provided the nearly vertical side slopes do not collapse before the lean mix is placed. The new piers would then be constructed directly on the lean mix concrete at the 3000 psf bearing pressure. CGC should be present during footing excavations to check that adequate soil conditions exist or recommend corrective measures, if necessary. Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should not exceed about 0.25 in.

Under this scenario, we anticipate that the floor slab section which extends beyond the reservoir limits would be designed as a structural slab to avoid the risk of settlement due to consolidation of the existing backfill.

### **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:

- Earthwork construction during the early spring or late fall 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.
- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.
- Based on observations made during the field exploration, groundwater infiltration into footing excavations is not expected to be a problem. However, 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 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:



Mr. Al Larson  
Madison Water Utility  
April 25, 2012  
Page 5

- Fill/backfill placement and compaction;
- Foundation excavation/subgrade preparation; and
- Concrete placement.

\* \* \* \* \*

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.**

William W. Wuellner, P.E.  
Senior Geotechnical Engineer

Michael N. Schultz, P.E.  
Principal/Consulting Professional

Encl: Appendix A - Field Exploration  
Appendix B - Soil Boring Location Plan  
Logs of Test Borings (2)  
Log of Test Boring-General Notes  
Unified Soil Classification System  
Appendix C - Document Qualifications  
Appendix D - Recommended Compacted Fill Specifications

cc: Scott Herkert, P.E., Strand Associates

**APPENDIX A**  
**FIELD EXPLORATION**

## APPENDIX A

### FIELD EXPLORATION

Subsurface conditions on site were explored by drilling two Standard Penetration Test (SPT) soil borings to depths of 40 ft below existing site grades. The locations were selected by CGC in consultation with Strand Associates. The borings were drilled on April 17, 2012 by Badger State Drilling (under subcontract to CGC) using a truck-mounted rotary drill rig equipped with hollow-stem augers and an automatic SPT hammer. The boring locations are shown in plan on the Soil Boring Location Map attached in Appendix B. Ground surface elevations at the boring locations were interpolated from a topographic map provided to us by Strand.

In each boring, soil samples were obtained at 2.5 foot intervals to a depth of 10 ft and at 5 ft intervals thereafter. 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.

2. Standard Penetration Test and Split-Barrel Sampling of Soils  
(ASTM Designation: D 1586)

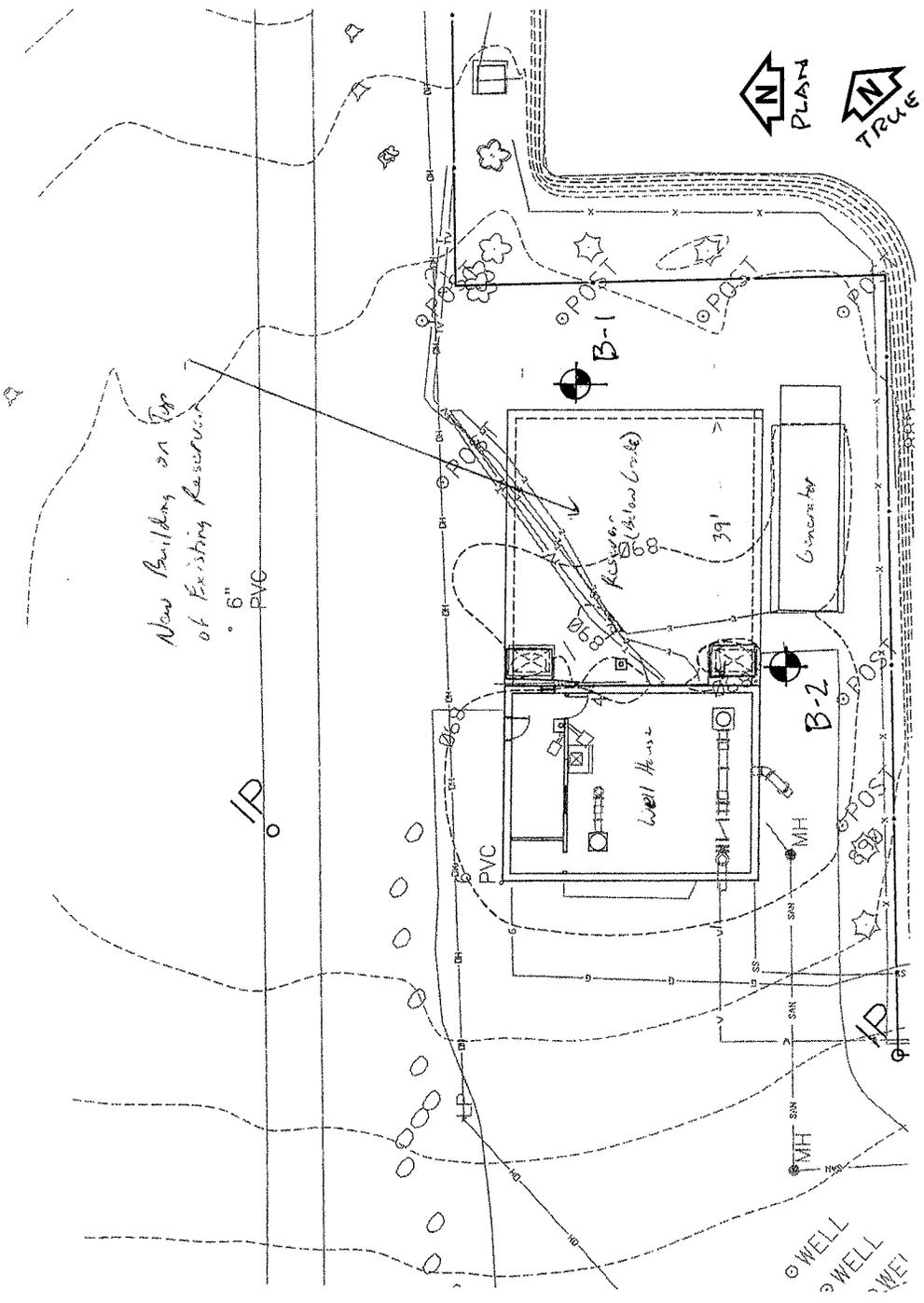
This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the drillers as these services were not part of CGC's work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were 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 logs prepared by the engineer and a description of the Unified Soil Classification System are presented in Appendix B.

**APPENDIX B**

**SOIL BORING LOCATION MAP  
LOGS OF TEST BORINGS (2)  
LOG OF TEST BORING-GENERAL NOTES  
UNIFIED SOIL CLASSIFICATION SYSTEM**

<b>SITE PLAN</b>		MADISON WELL NO. 15 VOC REMOVAL MADISON WATER UTILITY DANE COUNTY, WISCONSIN	
JOB NO. 1020.066	PROJECT MGR. ANDY MULLENDORE	 <b>STRAND ASSOCIATES®</b>	



SITE PLAN

**Legend**

- Denotes soil boring location and number

**Notes**

1. Soil borings performed by Badger State Drilling in April 2012.
2. Base map provided by Strand Associates.
3. Boring locations are approximate.

Scale: As shown

Date: 04/2012	Job No. C12083
------------------	-------------------

**CGC, Inc.**

**SOIL BORING LOCATION MAP**  
Well No. 15 VOC Facility  
Madison, Wisconsin



# LOG OF TEST BORING

Project Well No. 15 VOC Facility  
 Location 3900 East Washington Avenue  
Madison, WI

Boring No. 1  
 Surface Elevation (ft) 889.4  
 Job No. C12083  
 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.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (tsf)	W	LL	PL
1		12	M	7	7 in. Dark Brown Sandy Silt TOPSOIL					
2		16	M	8	FILL: Loose to Very Loose, Brown Fine to Medium SAND, Some Silt, Little Gravel (SM)					
3		12	M	6						
4		16	M	5						
5		10	M	3						
6		18	M	33	Dense to Very Dense, Brown Fine to Medium SAND, Some Silt/Gravel, Scattered Cobbles or Boulders (SM)					
7		16	M	67	Rough Drilling on Probable Gravel/Cobble Layer from 21 to 23.5 ft					
8		7	M	50/2"						
9		7	M	50/2"						
10		6	M	50/1"	Very Dense, Brown Sandy SILT (ML)					
					End Boring at 40					
					Borehole backfilled with bentonite chips					

WATER LEVEL OBSERVATIONS					GENERAL NOTES				
While Drilling	<input checked="" type="checkbox"/>	NW	Upon Completion of Drilling	<input type="checkbox"/>	NW	Start	4/17/12	End	4/17/12
Time After Drilling					30 min.	Driller	Badger Chief	RM	Rig CME
Depth to Water						Logger	DC	Editor	WWW
Depth to Cave in						Drill Method	2 1/4" HSA; Autohammer		

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



# LOG OF TEST BORING

Project Well No. 15 VOC Facility  
 Location 3900 East Washington Avenue  
Madison, WI

Boring No. 2  
 Surface Elevation (ft) 890.0  
 Job No. C12083  
 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
					3 in. Asphalt Pavement/9 in. Base Course					
1	16	M	18		FILL: Medium Dense, Brown Fine to Medium SAND, Some Silt and Gravel (SM)					
2	18	M	22							
3	12	M	13							
4	10	M	15							
					Possible FILL: Loose, Brown Fine to Medium SAND, Some Silt and Gravel (SM)					
5	18	M	7		Medium to Very Dense, Brown Fine to Medium SAND, Some Silt/Gravel, Scattered Cobbles or Boulders (SM)					
6	16	M	21							
7	18	M	34							
8	12	M	38							
9	18	M	54							
10	18	M	35							
					End Boring at 40 ft					
					Borehole backfilled with bentonite chips and asphalt patch					

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling <u>∇ NW</u> Upon Completion of Drilling <u>NW</u> Time After Drilling _____ <u>30 min.</u> Depth to Water _____ Depth to Cave in _____	Start <u>4/17/12</u> End <u>4/17/12</u> Driller <u>Badger</u> Chief <u>RM</u> Rig <u>CME</u> Logger <u>DC</u> Editor <u>WWW</u> <u>55</u> Drill Method <u>2 1/4" HSA; Autohammer</u>
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	3/4" to 3"	3/4" to 3"
Fine	4.76 mm to 3/4"	#4 to 3/4"
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 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>v</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 Designator
- RB--Rock Bit
- FT--Fish Tail
- DC--Drove Casing
- C--Casing: Size 2 1/2", 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" Diameter Split-Barrel Sample
- 2ST--2" Diameter Thin-Walled Tube Sample
- 3ST--3" Diameter Thin-Walled Tube Sample
- PT--3" Diameter 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>s</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--Caved 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.)		
<b>GRAVELS</b> More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
<b>SANDS</b> 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	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 of 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

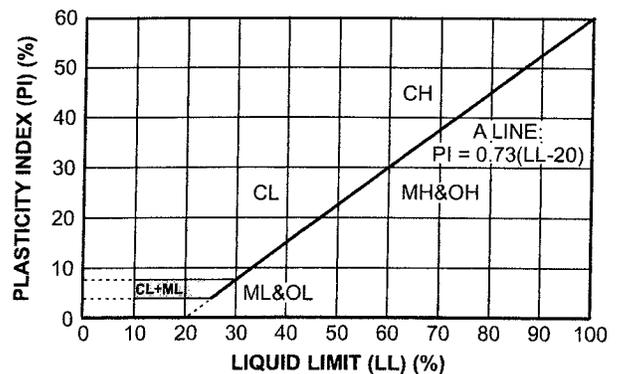
### LABORATORY CLASSIFICATION CRITERIA

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	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
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	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

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



**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

---

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.

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 study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

#### **MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION**

Site exploration identifies subsurface conditions only at those points where surface 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 construction recommendations included in your report. *Those 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 recommendations if we do not perform construction observation.*

## **A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION**

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having CGC participate in prebid and preconstruction conferences, and by providing construction observation.

## **DO NOT REDRAW THE ENGINEER'S LOGS**

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

## **GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE**

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

## **READ RESPONSIBILITY PROVISIONS CLOSELY**

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, 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.

## **GEOENVIRONMENTAL CONCERNS ARE NOT COVERED**

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

## **OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD**

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

## **RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE**

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of ASFE, for more information.

Modified and reprinted with permission from:

ASFE/The Best People on Earth  
881 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
Sieve Size	Percent Passing by Weight							
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	75 (2)		
No. 40			5-20	8-28	10-35	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><u>Within 10 ft of building lines</u></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><u>Beyond 10 ft of building lines</u></b>		
Under walks and pavements		
- Less than 3 ft below subgrade	92	95
- Greater than 3 ft below subgrade	90	90
Landscaping	85	90

**Notes:**

1. Based on Modified Proctor Dry Density (ASTM D 1557)